Mayo Clinic Number

THE SURGICAL CLINICS OF NORTH AMERICA

Volume 9 **Number 1**

CASES FROM THE CLINIC OF E. STARR JUDD

E. STARR JUDD

EXTENSIVE CARCINOMA OF THE STOMACH WITH PANCREATIC INVOLVEMENT: CASES IN WHICH SATISFACTORY RESULTS FOLLOWED RESECTION

Case I.—The patient was aged seventy-one years when examined in the Clinic in September, 1923. His chief complaint was stomach trouble of three weeks' duration. This consisted of pain in the epigastrium, which was more or less constant, and associated with a sense of fulness. He had lost 17 pounds since the onset of the illness.

Examination revealed a palpable mass in the epigastrium. The roentgenologist reported the presence of an operable carcinoma at the pyloric end of the stomach. Gastric analysis revealed the absence of hydrochloric acid. The hemoglobin was estimated at 73 per cent; the chemistry of the blood was normal.

On opening the abdomen September 12, 1923 a large ulcerating carcinoma was found at the pyloric end of the stomach with attachment to the anterior surface of the pancreas (Fig. 1). Distal metastasis or lymphatic involvement could not be found. Owing to the marked edema in the tissues and the attachment of the lesion to the pancreas, a great deal of difficulty was encountered in mobilizing the stomach. However, two-thirds of it was resected and the closure made according to the posterior Polya technic. The pathologist reported the presence

of a carcinoma, 8 by 7.3 cm., with involvement of the serosa, graded 3 (Fig. 2). The lymph nodes were not enlarged.

The immediate convalescence was uneventful. It was many weeks before the patient recovered strength sufficiently to go back to work. About nine months after the operation he became distinctly jaundiced, and it was presumed at that time that carcinoma had recurred. The jaundice persisted for several weeks but finally disappeared. After this he gradually improved in

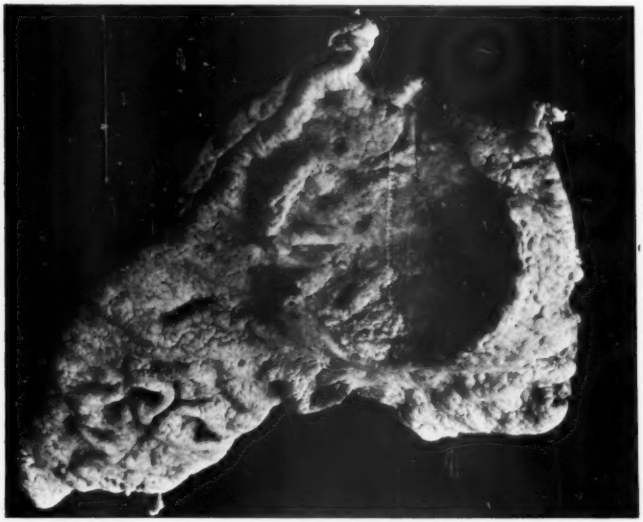


FIG. 1.—Large ulcerating carcinoma of the pyloric end of the stomach, 8 by 7.3 cm.

weight and strength and at the end of about eighteen months after the operation he was in a practically normal condition and resumed his usual occupation. He is an employee of the Clinic and so I have had an opportunity to observe his convalescence from day to day. Suggestions have been made regarding his diet and care, but he feels that he is better off working out his own plans. Although there are certain foods that are not well tolerated, on the whole he gets along nicely. At the present time he is not incapacitated in any way. He is now seventy-six

years old and apparently in a practically normal condition five years after resection of the stomach for an extensive carcinoma.

In view of the fact that many of these patients are refused operation because the growth is attached to the surrounding tissues as this one was, it seemed worth while to call attention to this case. At the time of operation the growth was defi-

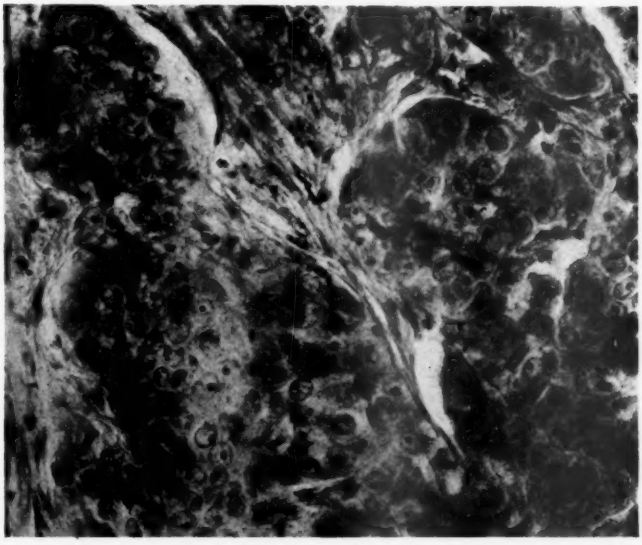


FIG. 2.—Section from the edge of the crater of the ulcer showing high-grade malignancy, as depicted by the large number of cancer-cells.

nitely sealed into the pancreatic tissues. In order to remove the diseased tissue satisfactorily it was necessary to traumatize the pancreas a good deal and parts of the pancreatic tissue were removed with the growth. It is true that not all patients with such extensive involvement do as well as this one; nevertheless, they should not be refused operation.

Case II.—The patient aged fifty-eight years had also had an extensive carcinoma of the stomach and obtained a result that was even more striking than that of the first patient. He

came to the Clinic in February, 1916. A tumor in the epigastrium was definitely palpable and the hemoglobin was 40 per cent. He complained of gaseous eructations and stated that he had known of the presence of a tumor for three months. He had lost strength for at least a year. He was poorly nourished. Up to the time of examination he had lost 31 pounds. Gastric analysis showed lack of free hydrochloric acid. The roentgenologist reported the presence of inoperable carcinoma of the body of the stomach. The growth was very large, as shown

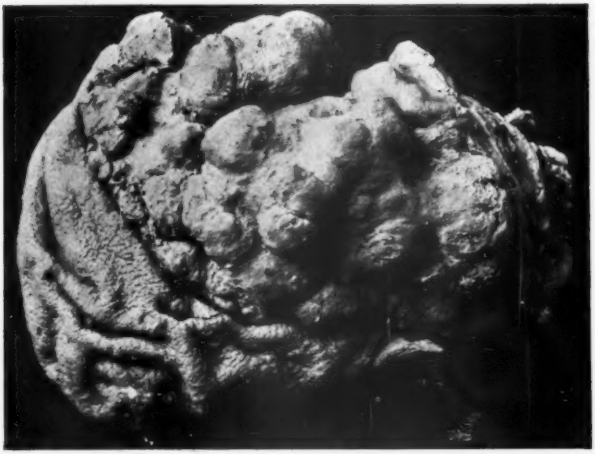


FIG. 3.—Portion of stomach containing a large nodular carcinomatous growth.

in Figure 3. Because of the poor condition of the patient and the type of the lesion, exploration was not urged; nevertheless, the patient requested it, and February 14, 1916, three-fifths of the stomach was removed and the capsule resected from the anterior surface of the pancreas, suturing over the pancreatic tissue. In this case there was also an extensive carcinoma of the stomach. The lymph nodes along the lesser curvature were involved. The tumor was attached to the pancreas. The pathologist reported extensive carcinoma of the stomach, graded 3, with lymphatic involvement (Figs. 3 and 4).

More than twelve years have elapsed since the operation. The patient is entirely free from symptoms and is carrying on an active busy life. He is now seventy years old.

In the first case, according to Broders' scheme of grading malignancy, the carcinoma was graded 3. The patient has lived five years since the operation. In the second case, twelve years have elapsed since the operation. In this case carcinoma was graded 2.

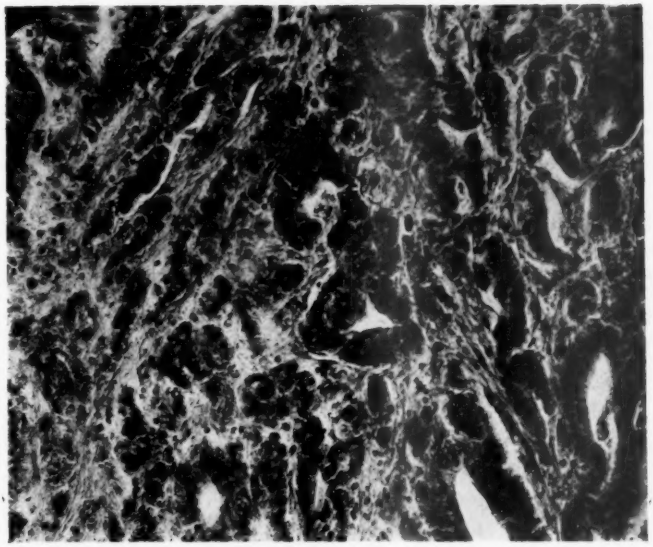


FIG. 4.—Adenocarcinoma, graded 2.

Statistical studies of the results of treatment of carcinoma are usually very discouraging, but it seems to me that if more of the cases were reported in which satisfactory results are obtained, considerable benefit could be derived from a study of them.

The results in these two cases of carcinoma of the stomach certainly justify the performance of extensive operations in the presence of lymphatic involvement and pancreatic attachment.

HEMANGIOMA OF THE DUODENUM

Case III.—A woman aged thirty-seven years came to the Clinic with the complaint that she had had four gastro-intestinal hemorrhages. The first and most severe hemorrhage had occurred about seven years previously. At that time she vomited clotted blood, was pale and weak, and was confined to bed for ten days. For two weeks afterward the stools were tarry. With the last hemorrhage (three months before admission) she vomited blood, passed tarry stools, and was weak. Two other hemorrhages had occurred four years and two years previously, unaccompanied by vomiting but followed by tarry stools and weakness. She had pursued a modified Sippy diet for a year after the first hemorrhage. Aside from mild indigestion and the hemorrhages she had not had symptoms referable to the gastro-intestinal tract.

The patient was well nourished. With the exception of infection in the tonsils the general examination was essentially negative. The urinalysis and blood Wassermann test did not reveal anything abnormal. Hemoglobin was 73 per cent; the erythrocytes numbered 4,650,000. Gastric analysis showed total acids 56, free hydrochloric acid 40, and 70 c.c. retention. Roentgenographic study showed the presence of a duodenal ulcer with a central filling defect beyond the crater, apparently a benign lesion.

At operation, September 10, 1928, a tumor resembling a hemangioma was found in the duodenum. Ulceration was present on the mucous surface and a large vessel ran into the tumor. The entire cap of the duodenum was excised together with the pyloric sphincter and the lower end of the stomach, including the growth. The vessels running into the lesion were ligated. A Cameron light was introduced into the stomach and duodenum; other lesions were not found. Closure was made as in gastro-duodenostomy. The pathologist reported an ulcerating hemangioma, 4.5 by 4 by 1.5 cm. (Fig. 5). Convalescence was uneventful.

Great difficulty may be encountered in locating the source of the bleeding that constitutes gastro-intestinal hemorrhage. It

may come from the vessels in the lower part of the esophagus as sometimes occurs in association with cirrhosis of the liver. In some instances free gastro-intestinal hemorrhages have occurred in cases of splenic anemia. Bleeding from an ulcer of the stomach or duodenum may cause a sudden severe hemorrhage. If the lesion is a carcinoma of the stomach, bleeding is more likely to be in the form of constant oozing. In cases in which blood is found in the stool, the possibility of the presence of

FIG. 5.—Hemangioma, 4.5 by 4 by 1.5 cm.

lesions of the large and small intestine must be borne in mind. With papilloma, especially of the sigmoid, it has sometimes been difficult to locate the source of bleeding. It does not often occur with diverticulitis, but frequently it is associated with carcinoma of the sigmoid. Severe anemia with the apparent loss of a very small amount of blood suggests the presence of carcinoma of the right half of the colon. Unfortunately many patients with this condition are treated for primary anemia.

In the case here reported there was definite hemorrhage each time bleeding was known to occur, but the patient rather rapidly returned to an apparently normal condition. There was some

dyspepsia, as is usual in these cases, but it was not sufficient to be typical of ulcer.

Hemangiomas more often arise from the stomach and are on a pedicle. Only a few have been found in the duodenum. In the Clinic, over a period of years, only seventy-three benign tumors of the stomach have been encountered, four of which were hemangiomas. New growths in the duodenum are relatively rare. In a large group of surgical cases only sixteen benign tumors of the duodenum have been found; three of these were hemangiomas. Tumors of the stomach may attain considerable size before they cause marked symptoms, but this is usually not the history of duodenal lesions. Primary malignant growth of the duodenum rarely if ever occurs, so that it does not have to be considered in determining the method of treatment.

STONES IN THE COMMON DUCT FOLLOWING REMOVAL OF THE GALLBLADDER

Case IV.—A man aged forty-seven years had had heartburn for many years; ten years before coming to the Clinic for examination he suffered an attack of rather severe epigastric pain with radiation. The patient thought that he was jaundiced at that time. The gallbladder, which contained stones, was removed. Bile drained from the wound for two months. One year after the operation he had an attack of epigastric pain accompanied by jaundice. Then for six years he was free from any trouble of this kind, but for three years just preceding his visit to the Clinic he had had attacks of moderately severe epigastric pain followed by jaundice, acholic stools, and pruritus lasting seven to ten days. The attacks became more frequent until during the last year they came about once in six weeks. Between attacks he felt well.

The patient was well nourished. The sclera showed slight icterus. The urinalysis and blood Wassermann test did not show anything abnormal. The hemoglobin was 73 per cent and leukocytes numbered 11,200. The serum-bilirubin was estimated at 1.8 mg. for each 100 c.c. of blood, and the van den

Bergh reaction was direct. The coagulation time was seven minutes. The blood urea was estimated at 22 mg. for each 100 c.c. of blood. Stools were normal in color, and by duodenal drainage bile was readily obtained. A flat roentgenogram of the area of the gallbladder did not show evidence of the presence of stones.

At operation multiple stones were found in the common duct. One of the stones (Fig. 6) was large, irregular in shape, and had a bulging protuberance at the lower end which apparently fitted

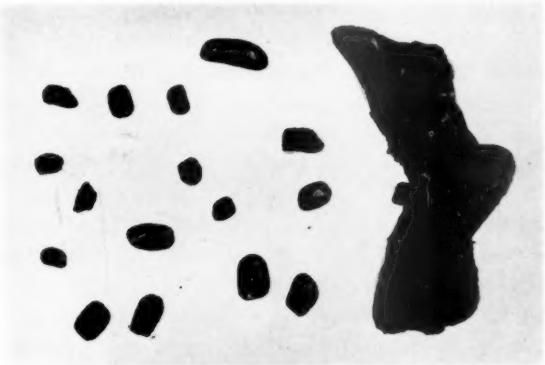


FIG. 6.—Stones removed from common duct.

into the ampulla. This large stone was caught with the forceps and extracted without being broken. The other calculi were removed with a scoop. Examination of the liver revealed hepatitis which was graded 2. For eight days bile drained from the Mayo-Robson drain which was left in the common duct. This tube was removed on the tenth day. There was serous drainage from the wound for several days, but when the patient was dismissed the wound was dry and he was in excellent condition.

It is to be noted that previous to cholecystectomy, jaundice may or may not have been present; at least it was not grossly evident since the patient was unable to make a definite statement regarding it. However, the history related that bile drained through the wound for two months following removal

of the gallbladder, which suggests that there was some interference with the flow of bile through the duct. The fact that drainage ceased, the wound healed, and the patient was practically free from trouble for several years, must be interpreted as meaning that the stones were either small or not present at that time.

Cirrhosis, hepatitis, or cholangitis might have produced jaundice, or pancreatitis could have been a factor in causing obstruction in the duct, but at least in some if not all of the numerous attacks in the last few years one would have expected to find chills and fever in association with the other symptoms. However, with cirrhosis, hepatitis, and cholangitis the gross jaundice is usually more enduring and a rather constant dull ache is present between exacerbations. Although fever, chills, and vomiting did not enter into the complaint and a flat roentgenogram of the biliary tract did not show any shadows suggestive of stone, nevertheless the patient had had typical attacks of pain followed by jaundice of varying degrees of intensity, and it seemed probable that there was calculus formation in the duct. The differential diagnosis of stone in the common duct and stricture is difficult. It has been shown that in 35 per cent of the cases in which the trouble is due to stricture, the pain and colic are indistinguishable from the same symptoms due to stone. In using the duodenal tube as an aid in establishing the diagnosis, it must be remembered that even though a stricture may be present a trace of bile will usually find its way into the intestine, and also that it is nearly always possible to obtain a good flow of bile through the tube as soon as the attack has subsided. Ordinarily persistent and complete obstruction of the duct is due to tumor in the ampulla, in the ducts, or the head of the pancreas.

Repeated observations and tests showed clearly that there was interference with the flow of bile. In any similar case in which there is a question as to the cause of the obstruction and the symptoms are increasing in frequency and severity, it would seem justifiable to give the patient the benefit of exploration while he still has some prospect of withstanding the procedure. In this case the patient was able to leave the hospital on the

eighteenth day following removal of the stone, and when dismissed from the Clinic he was in good general health.

PAPILLOMA OF THE RENAL PELVIS

Case V.—A man aged forty-one years came to the Clinic in September, 1928 complaining of attacks of abdominal pain twelve years previously. One year after the onset of pain appendectomy was performed, and ten months before admission cholecystectomy. The pain had always been hard to localize but since removal of the gallbladder it had seemed to consist of a dull aching sensation in the left lumbar region and occasionally in the left groin. Following severe pain the patient noticed that

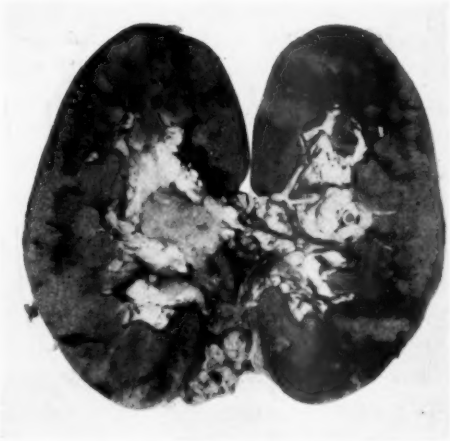


FIG. 7.—Papillary squamous-cell epithelioma of the pelvis of the left kidney.

the urine was dark, although urinary symptoms were not present.

The patient appeared to be in good health. Infected tonsils and two devitalized teeth were the only abnormal physical signs. Urinalysis revealed the presence of albumin, graded 3, erythrocytes, graded 4, and pus-cells, graded 1. The hemoglobin was 73 per cent and the leukocytes numbered 9,500. The blood Wassermann test was negative. A roentgenogram of the kid-

neys, ureters, and bladder showed multiple shadows over both kidneys, which were thought probably to be due to small stones. Further urologic investigation demonstrated normal function of both kidneys. A pyelogram showed nonsurgical minute shadows suggestive of stones in the tips of the calices of the right kidney, a similar shadow in the lower calix of the left kidney, and a filling defect of the left renal pelvis, which was diagnosed as a papillary epithelioma or a soft stone.

At operation, September 19, 1928, a small papillary tumor of the left kidney was found (Fig. 7). The kidney and about 5 cm. of the ureter were removed. The pathologist reported papillary squamous-cell epithelioma, 2.5 by 2.5 by 1 cm. Calculi were not found in the kidney.

With improved equipment and methods of investigation and the constant study of case histories in conjunction with the disease processes in the kidney, it is possible to make an earlier and more accurate diagnosis of the lesions causing deformities of the renal pelvis. This has permitted earlier removal of malignant tumors, possibly at a time when there is a chance to obtain a good ultimate result.

In this case the lesion was a papillary squamous-cell epithelioma. Hematuria, the characteristic symptom of renal neoplasm, had not occurred. It is present in 60 to 70 per cent of the cases of renal tumor. Careful roentgenologic studies are of especial value in making the differential diagnosis, particularly in cases in which such a cardinal symptom as hematuria has not entered into the complaint.

THE POSTOPERATIVE ADMINISTRATION OF OXYGEN AS A PROPHYLAXIS AGAINST PULMONARY COMPLICATIONS

LUIS A. PASSALACQUA AND E. STARR JUDD

In previous papers* from this Clinic attention has been called to the value of oxygen treatment of patients with cyanotic conditions, especially pneumonia. Reference is made in these papers to the earlier work in oxygen therapy of Stadie, Binger, and others. At present we wish to discuss the prophylactic use of oxygen postoperatively and to mention further experience in the treatment of patients who have developed pneumonia.

The patient who has been subjected to extensive operative procedures in the upper part of the intestinal tract, the biliary passages, or the pancreas, or who has suffered a moderately severe shock, usually does better if treated in the oxygen chamber or tent. This is particularly true of elderly patients with chronic pulmonary complications, such as chronic bronchitis, chronic asthma, and bronchiectasis, of debilitated patients, and of patients who are believed to have pulmonary tuberculosis, but it cannot be detected clinically or by means of the roentgen ray or laboratory methods.

Oxygen was given immediately after operation to a series of thirty patients who appeared most prone to pulmonary complications because of previous lesions of the lung or because of the severity of the operation (Table 1). Pneumonia did not develop in any case and the patients recovered uneventfully. The patients felt more comfortable, except for a certain amount of local discomfort as a direct result of the intervention.

* Binger, M. W., Judd, E. S., Moore, A. B., and Wilder, R. M.: Oxygen in the treatment of postoperative bronchopneumonia. Arch. Surg., 1928, xvii, 1047–1050. Boothby, W. M., and Haines, S. F.: Oxygen therapy. Jour. Am. Med. Assn., 1928, xc, 372–376.

The patient is placed in an oxygen tent as soon as possible after the operation. The air in the tent contains a concentration of oxygen between 40 and 50 per cent. This is kept in constant circulation by a motor which draws the air from the tent and forces it through a tank of lime to free it from an excess of carbon dioxid. After it has been thus purified it is passed through another tank containing ice and then it mixes with the oxygen coming from the oxygen tanks through water. The ice serves

TABLE 1

PROPHYLACTIC ADMINISTRATION OF OXYGEN*

Operation.	Cases.
Choledocostomy	5
Cholecystectomy; choledocostomy	4
Posterior gastro-enterostomy	4
Excision of ulcer and gastroduodenostomy	4
Partial gastrectomy	2
Cholecystectomy; appendectomy	2
Exploration for inoperable carcinoma of stomach	2
Hepaticoduodenostomy	1
Cholecystectomy; gastro-enterostomy	1
Anterior resection of the descending colon	1
Appendectomy	1
Plastic cecosigmoidostomy; appendectomy	1
Partial gastrectomy; sleeve resection	1
Cholecystectomy; repair of umbilical hernia	1
Total	30

* No cases of pneumonia in the series.

to keep the air cool and adds to the comfort of the patient. A rheostat regulates the speed of the motor. Usually the motor is kept at a low speed, and the oxygen gage at 7 liters a minute, which gives an approximately correct concentration of oxygen. The percentage of oxygen is determined as often as necessary by means of an oxygen meter. The patient is kept in the tent from eighteen to thirty-six hours.

Oxygen has also been used in eighteen cases of pneumonia following operation (Table 2). In this series our results were remarkable. Cyanosis disappeared, dyspnea abated, the patient was less restless, the temperature dropped from one to four

degrees, sleep was facilitated, and convalescence was established on the third day after the onset of the condition. In all of these cases of pneumonia the symptoms started in the evening following the operation. The temperature rose to 102° or 104° F. with moderate cyanosis and dyspnea, impaired resonance at the base of the lungs, decreased vocal fremitus and breath sounds, and multiple moist and crepitant râles (Fig. 8). This was followed a few hours later by frank pneumonia with positive roentgenograms. As soon as the prepneumonic stage was recognized the

TABLE 2

PNEUMONIA: TEMPERATURE NORMAL IN FORTY-EIGHT HOURS*

Operation.	Cases.
Posterior gastro-enterostomy; appendectomy	7
Cholecystectomy	3
Cholecystectomy; choledocostomy	2
Heineke-Mikulicz pyloroplasty; excision of ulcer	2
Right pelviolithotomy	1
Choledocostomy	1
Cholecystostomy and appendectomy	1
Reconstruction of common duct over T-tube	1
Total	18

*No deaths in the series.

patient was placed in the oxygen tent. In two instances pneumonia did not develop and we believed that it was aborted. In the other sixteen cases there was no doubt as to the nature of the complication; in most of them the diagnosis was confirmed by the roentgen ray (Fig. 8).

The course of the pneumonia is remarkably modified by the administration of oxygen. The temperature returns to normal or nearly so in from eight to eighteen hours. It rises again at the end of the twenty-fourth or thirtieth hour, and then terminates by crisis at the forty-eighth hour. The physical changes in the lungs disappear by the fourth or fifth day. The patients claim that the phlegm loosens sooner and that they can expectorate with greater facility when they are in the tent, and this suggests a beneficial effect on the organs of respiration.

When there is an area of consolidation in the lungs the unaffected parts undergo compensatory emphysema. The accessory muscles of respiration are called on to perform additional work to increase the amount of air introduced into the lungs so that the air cells can be filled with enough oxygen to supply the needs of the body. The increased activity places an extra burden on the patient already debilitated by the surgical intervention, the original disease, and the respiratory infection. In spite of this activity, or dyspnea, the patient remains cyanosed, and it is

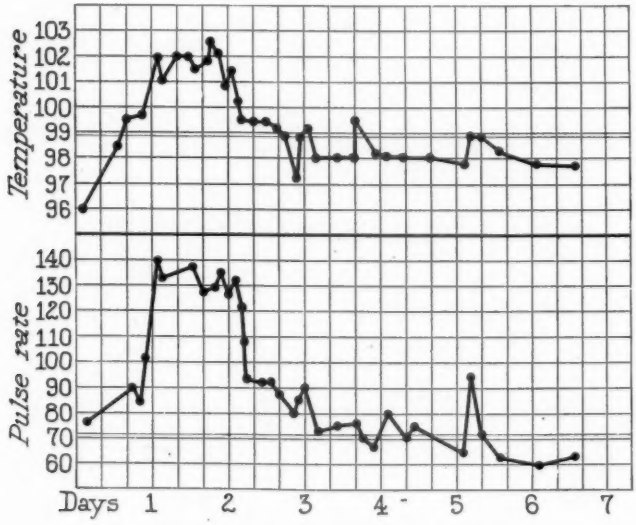


FIG. 8.—Pulse and temperature chart.

one proof that the mechanism of respiration is incapable by itself of absorbing from the ordinary atmosphere the amount of oxygen necessary to supply the bodily demand. Dyspnea produces fatigue, waste of energy, sleeplessness, and anxiety, and there is little doubt that it exerts a morbid influence on the recuperative powers of the patient. When oxygen is administered the cyanosis disappears, dyspnea abates, the patient is able to sleep and rest, the heart action is better, fever decreases,

and the patient does not need to be loaded with stimulating drugs because he has been saving good energy.

In the last few weeks oxygen has been given subcutaneously to four patients. To one was given 200 c.c. in the axilla; the others received 400 c.c. The oxygen was absorbed at an approximate rate of 20 c.c. a minute. There was transient disappearance of the cyanosis and the patient felt much better. It seemed to have produced some beneficial effects because the patients' general improvement was more rapid afterward. Local soreness at the site of the injection or untoward results were not apparent.

We are using an original apparatus consisting of an oxygen tank, a water manometer to measure accurately the quantity of oxygen, a pump to regulate the speed of the flow into the tissues, a sterile filter to free the oxygen of any dust, and to this is attached a sterile needle by means of rubber tubing. The oxygen is allowed to flow slowly, and it does not cause pain. This is just a preliminary report. We are supplementing our clinical observations with experimental data and expect, in the near future, to give a more complete and detailed report on the use of oxygen administered subcutaneously.

CASES FROM THE CLINIC OF DONALD C. BALFOUR

DONALD C. BALFOUR

BENIGN TUMOR OF THE STOMACH ASSOCIATED WITH MASSIVE GASTRIC HEMORRHAGE

Case I.—The patient, a woman aged sixty-four years, came to the Clinic with a history of gastro-intestinal hemorrhage. Two years before admission she had become weak, fainted, and vomited large quantities of clotted blood. A diagnosis was made of bleeding ulcer, but was not confirmed by roentgenologic examination. Following hospitalization a semisolid diet was prescribed; this was followed closely for two years. During this time there had not been hemorrhage or pain, but by close questioning a vague history of periodic attacks of epigastric discomfort was obtained. The discomfort, however, was not influenced by the taking of food and did not bear any relation to meals.

General examination was negative with the exception of slight tenderness on deep palpation over the midepigastrium, obesity, and blood urea of 71 mg. for each 100 c.c. Roentgenologic examination revealed a benign tumor high in the cardiac end of the stomach. While the patient was waiting for her final consultation she vomited a large quantity of blood, and for several days the bleeding was rather profuse. On the fourth day a transfusion was given. She continued to vomit coffee-ground material and passed tarry stools. The blood urea became progressively higher, the hemoglobin was 23 per cent, and the erythrocytes numbered 1,100,000. Following the transfusion hemorrhage ceased. Fluids were forced by mouth and by intravenous injection. The blood urea returned to normal and the hemoglobin gradually increased to 40 per cent.

August 9, 1928 a large pedunculated tumor, about 6 cm. in diameter, was located high on the posterior wall of the cardiac

end of the stomach. Because of the situation of the tumor it was difficult to deliver it even under considerable tension. When it was finally exposed a congested, crater-like ulcer about 1 cm. in diameter was observed on its summit. The pedicle was transfixed by a running mattress suture of chromicized catgut, before the tumor was excised. The anterior wall of the stomach and the abdomen was closed in the usual way.

The patient convalesced uneventfully and was dismissed from the hospital on the eighteenth postoperative day. She was feeling well and the hemoglobin had increased to 52 per cent (Fig. 9).

FIG. 9.—(Case I.) Showing crater of ulcer on a benign tumor.

In this case the rarity of a benign tumor situated high in the fundus of the stomach made it appear reasonable to consider that the lesion was malignant and irremovable. It was only because of some extraordinary experience with benign tumors in the past that exploration was urged, and it was found that the tumor was not malignant. The ulceration in the summit of the tumor probably explains the seriousness of the hemorrhage.

RECURRING PEPTIC ULCER FOLLOWING REPEATED PARTIAL GASTRECTOMY

Case II.—The patient, a man aged fifty-nine years, first came to the Clinic in 1922. He had suffered from peptic ulcer for fifteen years with only temporary relief on repeated courses of medical treatment. Roentgenologic examination revealed duodenal ulcer. The free hydrochloric acid was 70 and the total acid 90. At operation an ulcer of the duodenum was found and posterior gastro-enterostomy performed. There was complete freedom from symptoms for one year, when the distress returned in a similar but more severe form.

The patient returned to the Clinic in March, 1924 and a diagnosis of gastrojejunal ulcer was made and operation advised, but he deferred operation until April, 1926 at which time the diagnosis was corroborated. The anastomosis was disconnected and partial gastric resection with posterior Polya anastomosis was performed. Following this symptoms of ulcer were not present for three months.

In November, 1926 gastrojejunal ulcer was again diagnosed and another portion of the stomach was removed. After this operation distress returned within ten days. This increased in severity, and the patient returned to the Clinic in January, 1928. A third gastric resection was performed for recurrence of a large ulcer (crater about 3.5 cm. in diameter) on the mesenteric side of the jejunum. The anastomosis was made after the method of Roux (Fig. 10). The end of the distal portion of the jejunum was implanted into the end of the stomach after a large portion of the end of the stomach had been closed. Jejunostomy was added, and the patient was fed through the tube. The operation was extremely difficult because of inflammation of the mesentery of the small intestine, mesocolon, and gastrosplenic omentum. It is now almost a year since the last operation. The patient has been entirely free of pain and there is achlorhydria.

This case is a good example of the fact that partial gastrectomy is not necessarily a protection against the recurrence of ulcer. In spite of two resections, one of the largest jejunal ulcers

I have ever seen developed. The last procedure is interesting in that it brings up the question of whether there is less possibility of recurrence if the entire end of the stomach is not used for the new anastomosis. I am under the impression that in cases in which there is a high probability of recurrence a Billroth

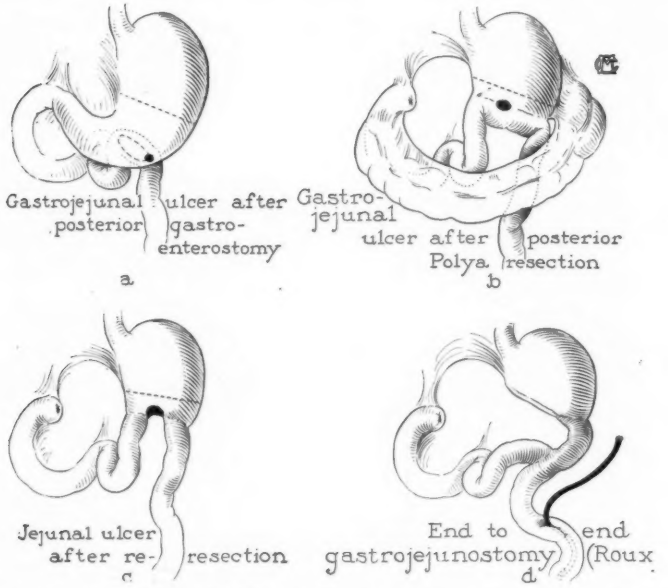


FIG. 10.—(Case II.) Multiple partial gastrectomy with recurring jejunal ulcers.

No. II with independent gastro-enterostomy would be less likely to be followed by ulceration than an end-to-side anastomosis of the Polya type. The use of the Roux method of anastomosis also may have some advantages. If ulceration develops in the future, it will be much more easily corrected since the gastro-enteric anastomosis can be disconnected and restored without regard to the drainage of the duodenal loop.

JEJUNOSTOMY FOR RECURRING PEPTIC ULCER FOLLOWING PARTIAL GASTRECTOMY

Case III.—A man aged forty-one years came to the Clinic in 1926 with a history and all clinical data characteristic of gastrojejunal ulcer. Gastro-enterostomy had been performed elsewhere in 1918 for duodenal ulcer, with complete relief for about a year when the old symptoms returned.

Partial gastrectomy was performed and, again, there was complete relief for a year; then, after a severe attack of influenza

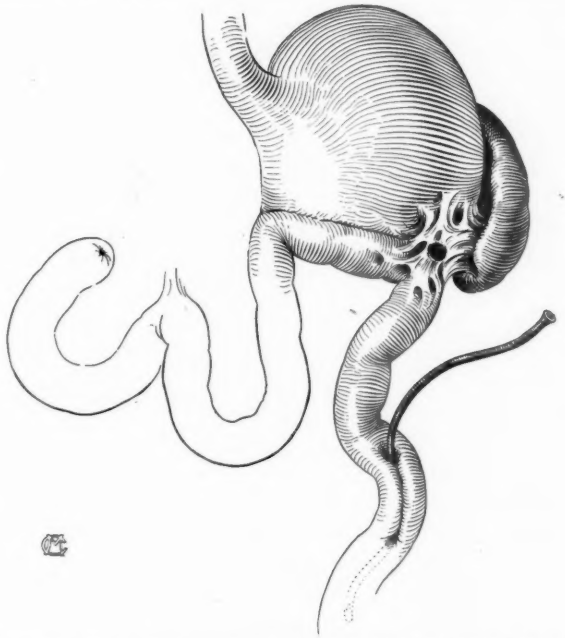


FIG. 11.—(Case III.) Perforated gastrojejunal ulcer adherent to the spleen.

which kept him in bed for three weeks, the former symptoms returned in a more severe form. He came back to the Clinic in October, 1927 and fluoroscopic examination disclosed extensive gastrojejunal ulceration. Severe pain radiated into the left side of the chest and shoulder, and the evidence was clear that the

ulcer had perforated onto the diaphragm, and that there was an extensive inflammatory process around it. As is customary in such cases, the patient was put in bed in the hope that much of the inflammation would subside and a radical operation could be performed. Little relief resulted however, and at the end of three weeks, operation seemed imperative.

A mass was found which filled the upper left side of the abdomen and involved the spleen. A huge crater could be identified in the anterior part of the anastomosis. Owing to technical difficulties and the great risk it was impossible to attempt operative procedures, and jejunostomy only was performed. Eight days afterward the patient was practically free of pain. He was allowed to go home with the jejunostomy tube in place. He coöperated very well and took nothing by mouth for six months. He returned in June, 1928 without symptoms, and all evidence of the lesion had disappeared. The roentgenogram was negative, and the gastric acids were low (Fig. 11).

I present this case because we occasionally forget the great tendency of ulcer to heal, and because of this tendency some simple medical treatment or conservative operation will often bring about complete healing. The jejunostomy will also permit, in some cases, a reasonably safe subsequent operation because of the rest which has been provided for the inflammatory process

FRACTURES OF THE NECK OF THE FEMUR

MELVIN S. HENDERSON

THE five cases herein reported are typical of the difficulties encountered in the treatment of fracture of the neck of the femur.

Case I.—A woman aged sixty-eight years, single, in good health, and carrying on an active business, while crossing the street, July 10, 1928, was struck by an automobile and thrown to the pavement. She was unable to stand on account of pain in the left hip, and was taken at once to the hospital.

FIG. 12.—(Case I.) Recent fracture of the neck of the left femur.

Movement of the left hip was extremely painful, and there was shortening of about 3 cm. Roentgenograms disclosed an intracapsular fracture of the neck of the left femur (Fig. 12). With the patient under anesthesia, on a fracture table, the

fracture was reduced, according to the method of Whitman, the foot inverted, and the leg swung out into full abduction. A double plaster-of-Paris spica cast was applied extending from the chest to the toes on the left side with the left leg in full abduction and the foot held inverted; on the right side the cast extended to the knee. Inversion of the foot is important, for it raises the trochanter anteriorly to its proper level. The patient was kept in this cast for approximately three months. Roentgenograms, taken November 1, showed good bony union (Fig. 13). Active physiotherapy, consisting of baking, massage,

FIG. 13.—(Case I.) Good union secured by Whitman method.

and active and passive movements, was instituted. In a few days the patient was able voluntarily to lift the leg from the table with the knee extended.

This case is an example of an intracapsular fracture of the hip treated immediately after the accident. There is no reason why a fracture of the hip, provided the patient is in reasonably good condition, should not be reduced immediately as a Colles fracture would be treated. Reliance on impaction, so often reported by the roentgenologist, is not to be lightly accepted.

Often what is interpreted as impaction is in reality overlapping, as I have proved to my satisfaction in two cases treated by open operation. Whitman has insisted that the rational treatment advocated by him will ensure union in the majority of cases. Campbell reported a large series of cases so treated, with excellent results. In this case full restoration of function will undoubtedly follow, but weight-bearing on the affected leg will not be permitted until six months after the accident.

Case II.—March 6, 1928, a nun aged fifty-five years slipped on the ice and fell. She did not know just how she landed, nor could she remember hearing a bone cracking. She did not experience any special pain until she attempted to get up. She was carried into the house on a chair. A physician was called, and roentgenograms taken, which revealed intracapsular fracture of the hip. She entered the hospital March 8.

Examination disclosed a thin but healthy woman weighing 115 pounds. There was loss of function of the left leg, and approximately 2 cm. shortening. Roentgenograms disclosed more comminution than is ordinarily seen in these fractures (Fig. 14).

The patient was averse to wearing a plaster-of-Paris cast, and accordingly an attempt was made to control the fracture by aid of a Thomas extension splint with the leg well abducted and the foot inverted. Because of the difficulties encountered in getting good position, as shown in the roentgenogram, and because of my experience recently in a somewhat similar case in which nonunion resulted, and inasmuch as anesthesia was necessary, it was decided best to perform an open operation. This was done March 24. The fracture was exposed by a Smith-Petersen anterior incision, and there was found to be considerably more comminution than had appeared in the roentgenograms. Parts of the capsule and fragments of articular surface were tucked in between the fragments. The fragments were lined up as well as possible after the tucked-in capsule and pieces of articular cartilage had been removed, and a beef-bone peg was placed in a channel bored through the trochanter,

through the neck, and well into the head. It was inserted a little higher in the head than usual, because that seemed to be

FIG. 14.—(Case II.) Recent fracture of the neck of the left femur.

FIG. 15.—(Case II.) Good union six months after operation; beef-bone peg in place.

the most satisfactory way to control the position of the fragments. The leg was then put up in abduction and a plaster-of-Paris cast was applied, extending from the chest to the toes on the affected side and to the knees on the other side; this was left on for three months, when it was removed and a single spica cast to below the knee on the affected side was put on. A roentgenogram taken November 1, six months after operation, showed good bony union (Fig. 15).

This case illustrates the occasional necessity of resorting to operation in recent fractures of the hip. I feel confident that if this had not been done, the pieces of capsule and articular cartilage resting between the fragments would have been sufficient to prevent union. This particular type of comminuted fracture, I believe, explains some of the occasional failures of the Whitman method wherein all the requisites of the treatment have been faithfully carried out. It is in such cases, in which reasonable doubt exists as to efficacy of conservative measures, that operation should be resorted to, under proper conditions. The beef-bone peg was used as it seemed to be the most appropriate way to steady the fragments and hold them in proper relation to each other. A beef-bone peg is strong and is finally absorbed by the host's bone.

Case III.—A woman aged fifty-three years was examined in the Clinic September 24, 1928. Eight months previously she had slipped and fallen on the floor. A diagnosis was made of fracture of the neck of the left femur and the next day, without anesthesia, a cast was applied; this was worn for six weeks. In two and a half months from the time of injury, weight-bearing was permitted on two crutches, but without brace or cast. When she was seen she was still using two crutches, and said that the leg gave way if she put any appreciable weight on it.

Examination showed a well developed woman, 5 feet 2 inches tall, weighing 113 pounds. Movements of the left hip were limited, the patient was unable to lift the leg off from the examining table with the knee extended, and there was 2 cm. of actual shortening. Roentgenograms disclosed ununited frac-

ture of the neck of the left femur. Operation was advised, preferably a bone grafting procedure, since the head of the femur appeared to be in good condition and a sufficient amount of neck seemed present (Fig. 16).

September 27, the hip-joint was exposed by an anterior incision, and typical fibrous union was found. To obtain better exposure the trochanter with its attached muscles was lifted upward. The head of the femur was found to be fairly well

FIG. 16.—(Case III.) Nonunion of fracture of the femur of eight months' duration.

nourished and the neck, although partially absorbed and a little atrophic, was believed to be in a condition to warrant a bone grafting operation. Accordingly, a bone graft was taken from the flat internal surface of the left tibia as high up near the proximal epiphyseal line as possible, and was driven through a hole which was bored through the trochanter and into the head. The graft was driven up rather high in the head and, then, multiple scrapings from near the epiphyseal line of the tibia were packed in between the head and neck just below the bone graft.

With the graft in the upper portion of the head, abduction served to bring the lower portion of the head more securely against the neck. Good position was secured and the leg was put up in full abduction. A double spica cast was applied, extending from the chest to the toes on the left with the leg in abduction and to the knee on the right. The trochanter with its muscles was now brought back down, and sewed onto the femur. The different steps of the operation were accomplished satisfactorily (Fig. 17).

FIG. 17.—(Case III.) Bone graft (piece of tibia) holding fragments.

Although the fracture in this instance was diagnosed immediately after the injury at the patient's home, and a cast applied the next day, an anesthetic was not given and an attempt was not made to reduce the fracture. The cast was left on for only six weeks and the patient was allowed to bear weight within two and a half months from the time of the accident. Those experienced in the treatment of fractures of the neck of the femur well know that bony union cannot possibly occur in less than three months, and it is now generally accepted that

weight-bearing should not be permitted before six months. Cotton has called attention to the apparent melting away of bony union in some cases of fracture of the neck of the femur: everything may look well, and the patient may be dismissed and told to use the leg, but when he is seen several months later, typical pseudarthrosis has again formed. If there is any doubt as to the strength of bony union, weight-bearing should be absolutely prevented, crutches and a Thomas walking caliper splint being used until such time as the roentgenograms show real bony union.

Case IV.—A nun aged fifty-two years was examined June 11, 1928. One year previously the patient had stepped backward from the running board of a moving automobile, and was thrown to the ground, sustaining a fracture of the neck of the left femur.

FIG. 18.—(Case IV.) Nonunion of femur of one year's duration.

She was in bed twelve weeks, Buck's extension only being applied. She was then allowed to get up, but was unable to walk.

The patient was in good general condition and weighed 140

pounds. Shortening of the leg was approximately 2.5 cm. Roentgenograms showed marked absorption of the neck of the left femur (Fig. 18). Three cardinal clinical signs showed very evident lack of union: namely, pain and semicrepitus in the hip on manipulation, inability to lift the leg from the table with the knee extended, and the shortening. In order to determine whether a bone-grafting operation was possible, another

FIG. 19.—(Case IV.) Modified Brackett operation; head held on femur with beef-bone screws.

roentgenogram was taken while the leg was pulled firmly and the foot was held slightly inverted. This brought the neck of the femur down into a good line with the head, thus showing a much better condition of the neck than had been anticipated; this made a bone grafting operation seem feasible. The patient was told that if, at the operation, the bone grafting was felt to be impracticable, either a modified Brackett or a Whitman operation would be performed.

The joint was exposed by a Smith-Petersen incision, revealing typical pseudarthrosis. What in the roentgenograms had appeared to be a good condition of the neck proved to be only the anterior shell of the neck, the central and posterior portions being entirely worn away. A bone grafting operation was clearly not practicable. Therefore, the head was freed from the acetabulum entirely and lifted out; it was held securely in moist gauze and the fracture surface freshened. The upper end of the femur was carefully reshaped and the prepared head placed on the upper end of it, the head being held in place by the aid of two beef-bone screws placed in through the top of the head into the upper end of the femur. This remodeled articular end of the femur was then replaced in the acetabulum, permitting good motion. The trochanter was reattached at a slightly lower level on the femur. A roentgenogram taken four months later (Fig. 19) showed bony union of the head to the femur. Soon after this roentgenogram was taken the patient began to bear weight on the leg, and is now making rapid progress.

Case IV is an example of a result that might be expected to follow measures which, although promptly instituted at the time of the accident, were but perfunctorily carried out as a sort of surgical ritual, and not as an intelligent plan based on the lesion present. Buck's extension in bed had been kept on for three months, no attempt apparently being made to provide inversion of the foot and abduction of the whole leg. The former raises the trochanter and neck anteriorly to its proper level and permits coaptation of the fractured surfaces; the latter locks them in position. The constant rubbing of the fragments with the leg everted had worn away the posterior and central portion of the neck, not leaving enough of the neck to permit of a bone grafting operation. The method used, that of removing the head entirely and bringing it out into the wound, freshening the fractured surface and placing it as a graft on the remodeled upper end of the femur, anchoring it with beef-bone screws, worked out very well. The replacing of the trochanter, which was lifted up, with its attached muscles, at a lower level is important

as it takes up the slack in the gluteal muscles and gives them an opportunity for better function.

Case V.—A nun aged fifty-nine years was examined August 13, 1928. Nine months previously she fell and broke the right hip. She was placed in bed with the leg in extension, and was allowed to walk about three months later. At no time since the accident had she been able to bear weight on the leg, and she was walking on crutches when she came for examination.

FIG. 20.—(Case V.) Nonunion of the femur of nine months' duration; much absorption of neck.

Examination disclosed a rather thin woman weighing 98 pounds. Roentgenograms disclosed a fracture of the neck of the femur with almost total absorption of the neck (Fig. 20). There was a trace of albumin in the urine, and although chronic mitral endocarditis with mitral stenosis was present, it was apparently compensated. There was no history of cardiac break, and therefore it was not considered that the condition of the heart was a contraindication for necessary surgical procedures.

On account of the pain and disability it was decided that some sort of skeletal weight-bearing should be provided, and the Whitman type of reconstruction operation was recommended. Accordingly, August 16, the hip was exposed through a modified Smith-Petersen incision, and after the trochanter with its attached muscles was lifted, the head was excised, the upper end of the femur reshaped and placed in the acetabulum, and the trochanter fastened back at a lower level on the femur

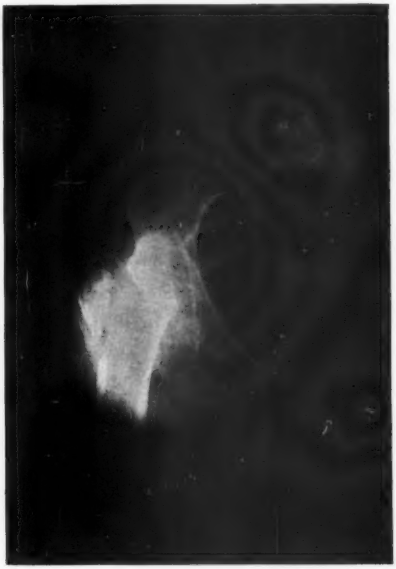


FIG. 21.—(Case V.) Skeletal support provided by Whitman reconstruction operation.

(Fig. 21). The cast was removed in three weeks and movement was encouraged. The patient is now walking on crutches, three months after the operation, and the result promises to be excellent.

In this type of case, wherein it seems best to provide skeletal support, the Whitman reconstruction operation, because of its simplicity and the speed with which it can be performed, is a

safe procedure. The movement of the hip following this operation is not as good as that following the bone graft or the Brackett operation, but stability is good and the primary requisite in these cases is skeletal support. This case, on account of the cardiac lesion, was not the best type of a risk and the short time required for this operation made it the one of choice.

CASES FROM THE CLINIC OF HENRY W. MEYERDING

HENRY W. MEYERDING

OSTEOMA OF THE UPPER THIRD OF THE LEFT TIBIA WITH CYSTIC AREAS, FOLLOWING OSTEOMYELITIS

Case I.— The patient, a farmer aged twenty-two years, was examined in January, 1925 because of a deformity of the left knee. Six years previously he had had an attack of pain and tenderness about the left knee with swelling and local heat. The leg was kept in a plaster-of-Paris cast for six months without relief, and nine months after the onset of the complaint an incision was made and pus drained, following which the pain gradually disappeared, leaving enlargement and deformity of the knee.

The circumference of the left knee was 47.5 cm. and that of the right 37.5 cm., and there was a scar on the outer side of the left knee. Palpation disclosed bony hardness of a tumor of the upper part of the tibia. There was about 10° movement in the knee-joint and the knee was held at about a right angle position. The patella was movable, without local heat or signs of inflammation. Urinalysis showed a trace of albumin but was otherwise negative; the Wassermann reaction on the blood was negative. Roentgenograms of the chest were negative. From roentgenograms of the left knee, femur, and tibia the roentgenologists diagnosed chondrosarcoma, involving the upper part of the tibia, the fibula, and the condyles of the femur. From further roentgenograms probable chondroma was diagnosed. The clinical diagnosis was old osteomyelitis of the upper part of the left tibia with chronic osteitis, producing marked hyperplasia of bone, deformity, and stiffness.

After carefully considering conservative operative procedures, the patient and his parents decided in favor of amputation.

February 6, 1928 supracondylar amputation through the femur was performed. With a tourniquet, the tumor, which was 15 cm. in diameter, was explored and found to consist of bone, with cystic areas from old inflammation (Fig. 22). This mass involved the upper third of the tibia. The patient's convalescence was uneventful and on the twenty-fifth postoperative day he was dismissed; the wound was healed and he was walking with crutches. He is wearing an artificial limb and has remained well following the operation.

FIG. 22.—(Case I.) Osteoma of the tibia following osteomyelitis, the diagnosis of which was confirmed by operation. The roentgenologic diagnosis was chondrosarcoma.

No doubt the infection in this case was low-grade, and a tremendous overgrowth of bone resulted. Secondary infection of the knee must have occurred and drainage of the knee-joint about three months after removal of the cast resulted in the relief of local pain. As is common in these cases flexion deformity of the knee and stiffness occurred, so that the leg was useless in walking. The possibility of a malignant growth was considered, but the history was definite for infection, and this

together with the clinical data suggested to the surgeon the benign character of the lesion. Although many claim that the roentgenologic examination is diagnostic, there are many instances in which knowledge of the history and the clinical manifestations are of considerable value in diagnosis, and this should always be borne in mind. In this case the roentgenograms showed a diffuse, clear-cut, sclerosing mass involving bone, distending it with clear-cut margins, but there was no evidence of invasion. Sclerosing sarcoma may simulate this condition somewhat, but it is usually accompanied by more severe pain, joint movement is not impaired so early, and deformity is not so common as it is in inflammatory conditions of the bone.

It is interesting to note that both the parents and the patient decided against a conservative operation, preferring an artificial limb unless they could be assured of a good functional knee-joint. The case further illustrates the necessity of early drainage in diseases of bone, in order to prevent deformity and disability.

RADIAL DEFLECTION DEFORMITY OF THE WRIST, DUE TO NONUNION FOLLOWING OSTEOMYELITIS

Case II.—The patient came for consultation in July, 1925 at the age of sixteen years, complaining of shortening of the left forearm, nonunion of the left radius, and a radial deflection deformity, the result of osteomyelitis. Eight years previously the left elbow had been injured and a superficial abrasion resulted in pain and swelling. The elbow was first treated with hot applications, later with casts, and finally with four operations for osteomyelitis, which resulted in nonunion of the left radius, marked deformity of the hand, and disability.

Examination showed the patient to be well developed and well nourished. The urinalysis and the blood and Wassermann tests were negative. The left forearm was markedly deformed and multiple scars were present. There was no evidence of local heat, but there was marked radial deflection of the left hand and wrist, due to loss of bone in the radius.

At operation about 3.5 cm. of the lower end of the ulna was removed and transplanted into the area of nonunion of the

radius. A plaster-of-Paris cast was applied to include the elbow and extend to the fingers. The graft was fitted in securely and multiple small bone chips were inserted about the area. The patient was dismissed on the twenty-first postoperative day, wearing a cast; the stitches had been removed, and the wounds were healed. She was to be under the care of her local physician for a change of cast and for observation. She returned six months later and examination showed new bone and firm union. She was dismissed without support and instructed to use the arm constantly in order gradually to increase function. The motions of the fingers were good. There was about 45° motion in the wrist-joint and the elbow could be brought to a right angle and extended to about 45°. The hand was about half the size of the other, due to nonuse and to loss of function during the growing period.

Deformity after osteomyelitis is not uncommon, following the loss of large sequestra. Care should be taken to preserve the sequestrum until a sufficient involucrum is formed to protect against fracture and nonunion. The patient's principal concern in this case was a grotesque deformity, and lack of function of the hand. Because of the long duration of the deformity, scarring, and so forth, it was thought impossible to lengthen the radius sufficiently; excision of the ulna, using this bone as a graft to the radius, was considered feasible. The use of multiple bone chips about the massive graft taken from the ulna was believed of considerably more importance in obtaining rapid union. At the end of six months union was sufficiently firm to allow the patient to discard all fixation.

CHRONIC INFECTIOUS ARTHRITIS WITH MULTIPLE ANKYLOSIS OF JOINTS

Case III.—The patient aged twenty-one years, with a previously negative history, came for consultation because of pain in many joints. Symptoms had begun seven years before with pain in the right shoulder; it wandered from joint to joint and the patient was treated for rheumatism. She required crutches and had been disabled for the last two years, during which time

she had been sitting in a wheelchair, trying to do some needlework. Tonsillectomy, baths, and medication had apparently been of little avail; the infection had progressed, leaving her incapacitated.

The hips and knees were flexed. The patient was pale and emaciated, weighing only 65 pounds. The hemoglobin was 63 per cent. The knees could be forced through 60° of motion, the range being from 90° to 150°. Roentgenograms showed multiple destructive arthritis of the hips, knees, and wrists. There was fair motion in the right hip and the left hip was held stiff in a flexed position. The spine was stiff (Fig. 23).

FIG. 23.—(Case III). Ankylosis of the right wrist and fingers, and deformity after nine years of chronic infectious arthritis.

The patient was advised to enter the hospital for gradual extension of the knees and hips in an attempt to enable her to walk. Casts were applied and the knees were gradually straightened by wedging, then tripod walking in casts with a walker was instituted, and later braces and crutches were used. At the end of five weeks she returned with the knees straight, wearing braces in the daytime and half casts at night. Instructions were given to continue with heat, massage, and exercises.

The patient was not seen again until February, 1927, two years later; during the interval the joints had gradually grown stiffer. Roentgenograms showed destructive arthritis, with ankylosis of joints. Clinical examination disclosed firm ankyl-

osis of both elbows, and ankylosis of the right knee. There were a few degrees of motion in the left knee and right hip. Examination of the wrists and fingers showed marked deformity, with multiple dislocations, and ankylosis of the wrists and phalangeal joints. The patient was totally disabled and required constant care.

Arthroplasty was performed on the left elbow for bony ankylosis, and fascia lata was inserted. The arm was put up at right angles for ten days, and then physiotherapy was instituted. Practically normal motion resulted, and the patient was greatly pleased with this improvement. March 28, 1927 arthroplasty was performed on the left hip, after the method of Murphy, and a double spica cast was applied for a period of ten days to improve the position of the feet and knees, and to give temporary rest to the hip until healing was assured. This was followed by physiotherapy, and the result in the hip was excellent. The patient had more than right-angle flexion (extension to 172° and flexion to 80°), and the hip moved without difficulty when she walked.

In February, 1928 arthroplasty was performed on the right elbow for bony ankylosis, fascia lata being used. Physiotherapy was begun after about ten days and a splendid functional result was obtained. March 2, the Mayo operation for bilateral hallux valgus was performed because of painful deformities of both great toes, with subluxation of the joints which made it difficult for the patient to wear shoes and to walk. Following this operation she had good motion, and was able to wear shoes and to walk with a great deal less discomfort. March 9, osteotomy of the right wrist was performed for ankylosis and deformity, a wedge of bone being removed sufficient to permit the hand to be put up in moderate extension. April 20, examination showed normal motion in both elbows. April 23, arthroplasty of the proximal phalangeal joints of the third and fourth fingers of the right hand was performed, and the fourth toe on the right foot was amputated. Animal membrane was used for the arthroplasty and banjo splints were applied, with extension, and were attached by adhesive to the fingers, changing the

position of the splints and the pull as correction was obtained. April 28, arthroplasty of the proximal phalangeal joints of the middle and fifth fingers of the right hand was performed, using animal membrane, and a horn-nail with the matrix was removed from the second toe of the left foot. May 27, arthroplasty of the proximal phalangeal joints of the middle and fourth fingers of the left hand was performed. May 28, the tips of the metacarpal bones of the index and middle fingers of the right hand were removed. The bony ends projected out in almost needle-like points, due to erosion and destruction of the joints. June 22, the patient was dismissed, at which time there was good motion in all of the arthroplastic joints, and she was able to walk, to feed herself, and to embroider.

After approximately nine years of infectious arthritis this patient had become a total invalid. She was unable to walk or to feed herself, and she required constant care. In the two-year interval between consultations in the Clinic ankylosis of the joints had taken place, all medical and conservative treatment having failed to stop the progress of the disease. Surgical procedures and postoperative physiotherapy were then the only means of relief from what would otherwise have been permanent total disability.

Postoperative physiotherapy for arthroplasty is usually started about the third or fourth week. A little superficial heat is given, application for from five to ten minutes being sufficient. The region of the scar is avoided since the heat tends to spread the scar. Gentle massage precedes the exercises. Movement will be guarded at first and the patient's confidence must be gained; for this reason it is sometimes better to leave the part on the splint for the first day or two. Emphasis should be placed on the development of the musculature controlling the joint, setting of the muscles being started early in the treatment. This must be thoroughly understood by the patient first and then he is encouraged to do this exercise often during the time between treatments. When the knee or hip is affected the whole leg, including the foot, should be treated; if the elbow has been operated on, the shoulder, hand, and wrist should be treated,

exercises being given to any weakened muscles in the extremity. Very little forced movement is used since the passive movement should not be allowed to get too far ahead of the active movement for this may result in an unstable joint and will give unnecessary pain. Relaxed motion, therefore, after arthroplasty is to be preferred. It is not unusual for a period of pain and increased soreness to occur, and treatment should be suspended until this subsides. If the patient is told that this is a possibility, that the maximal result may not be obtained for many months, and that he should concentrate on building up the muscle power around the joint, he will be content to do so and his intelligent coöperation will be gained. In a case in which a joint has been ankylosed for some time, joint and muscle sense may be lost, and time will be saved in the end if the operation can be preceded for a week or ten days by physiotherapy.

By means of repeated arthroplasty, manipulation, brisement forcé, and physiotherapy the patient in this case has been rescued from total disability, and is now able to lead a useful life.

BENIGN TUMOR OF THE FEMUR, PREVIOUSLY DIAGNOSED AND TREATED AS MALIGNANT

Case IV.—The patient was a clerk aged thirty years who had been having pain in the right upper part of the abdomen radiating to the right lumbar region and back for the last four or five years, without vomiting or jaundice. Appendectomy had been performed with temporary relief. Tumor in the region of the right hip had also been present for about six months. He had been treated for sarcoma by radiotherapy and Coley's toxins without any apparent effect. The tumor had been considered inoperable, and the patient was greatly worried regarding malignancy and the prognosis.

The patient was about 20 pounds underweight. Blood pressure, temperature, and pulse were normal. Urinalysis and blood Wassermann tests were negative. The tonsils had been removed previously. A roentgenogram of the left hip showed a mass in the left femur, which was diagnosed osteochondroma (Fig. 24). Roentgenograms of the chest, left ankle, and gall-

bladder were negative. There was a large, fairly well circumscribed firm and fixed mass around the greater trochanter of the left femur. The skin was not attached, and from palpation of the tissue the tumor was believed to be more or less encapsulated. Exploration and removal of the tumor were advised. Cholecystitis with stones was also diagnosed and operation advised. The patient, however, was more concerned about the leg and wished to have the tumor explored first, and removed if possible.

FIG. 24.—(Case IV.) Osteochondroma of the left femur before operation.

The tumor, 17.5 by 12.5 by 10 cm., was found to be encapsulated by a bursal sac which was completely excised. The growth arose from the lesser trochanter. The pathologists reported osteochondroma. The patient recovered uneventfully and he was dismissed on the twelfth day with the wound healed and in good condition (Fig. 25).

There can be little doubt that this tumor had been present for several years. The six months' history, the extreme size, and the apparently rapid growth may have misled the attending surgeon to diagnose malignant tumor. I have observed similar

cases in which large osteochondromas or chondromas have undoubtedly existed for years, but have not been recognized. These tumors do not react favorably to radiotherapy or toxins, and should be treated surgically early in order to prevent injury to surrounding tissue from pressure, and to avoid the difficulties attending the removal of large masses which sometimes cause irreparable injury.

FIG. 25.—(Case IV). Same case as that shown in Figure 26, after excision of osteochondroma.

In a series of 265 cases of osteochondroma at The Mayo Clinic, in 232 of which operation was performed and the diagnosis confirmed pathologically, the average age of the patients was approximately twenty-seven; the youngest patient was five and the oldest was sixty-four. There were 150 males and eighty-two females. Although heredity is an acknowledged etiologic factor, trauma and metabolic disturbances in childhood must also be considered. Thirty-nine per cent of the

patients examined gave a definite history of injury to the part affected, although in many instances the trauma was undoubtedly the cause of recognition rather than the cause of the tumor itself. The age incidence in cases of exostosis was somewhat similar to that in sarcoma of the long bones; 80 per cent of the former and 75 per cent of the latter occurred between the ages of eleven and forty. In osteochondroma or exostosis pain is not a common symptom. Patients may have such a tumor for years without noticing it, then attention is called to it by dull aching. Often the tumor is covered by a bursa which becomes inflamed by trauma or irritation, and may suddenly increase and alarm the patient who fears that a carcinomatous change in the tumor may be taking place.

Examination of these tumors usually shows the skin to be smooth, normal in appearance, and freely movable. There is slight tenderness on firm pressure, but seldom any venous congestion. The most common sites for exostosis are the knees, shoulders, and ankles. The growths usually arise from the diaphysis, near the epiphyseal line. Surgical removal is indicated when the tumors cause deformity and limitation of movement, and it should not be delayed until they have attained such size as to cause irreparable injury to the shaft of the bone. Following excision of the tumor I usually cauterize the base and insert a rubber-tissue drain for a period of forty-eight hours to drain the blood to the surface and thus prevent hematoma. The prognosis in these cases is good.

TRAUMATIC SPONDYLOLISTHESIS

Case V.—A man aged forty-six years complained of having had pain in the lower part of the back and thighs for seven months, after having fallen down some steps striking his back and severely injuring the lower part. A sharp pain, so severe that he was unable to move, radiated to the back and thighs. A few months later, while in the hospital, the patient was operated on for acute appendicitis. He was dismissed about two months afterward, very much improved but not entirely well. He was unable to work because of constant pain and disability.

The patient was 6 feet in height, and weighed 155 pounds which was about 25 pounds less than his usual weight. Blood pressure, temperature, and pulse were normal. He walked with a careful gait and held the muscles in the back rigid; there was definite stiffness in the lumbar spine. Slight kyphosis was noted over the fifth lumbar vertebra and a slight depression just above this. Spondylolisthesis was suspected. Anteroposterior and

FIG. 26.—(Case V.) Lateral view of spine. The fourth lumbar vertebra is displaced forward on the fifth. Spondylolisthesis was diagnosed.

lateral roentgenograms disclosed the fourth lumbar vertebra displaced forward on the fifth, and spina bifida occulta (Fig. 26). The tonsils were enlarged, but not definitely infected; two teeth showed evidence of periapical infection. The urinalysis and Wassermann reaction on the blood were negative. A fusion operation was advised. The patient returned home wearing a belt, which afforded some relief.

June 1, 1928 the patient returned for operation and an autog-

enous bone graft was placed so as to fuse the sacrum and the third, fourth, and fifth lumbar vertebræ. Convalescence was uneventful and July 18 he was dismissed, free from pain. A letter received subsequently stated that he had remained well.

Spondylolisthesis is more common than is ordinarily believed. In every instance of severe trauma to the lower part of the back it is of extreme importance to take lateral roentgenograms of the lumbosacral area as well as anteroposterior views, since anteroposterior roentgenograms often fail to demonstrate clearly the true condition, while it is much more readily recognized in lateral roentgenograms. This type of lesion was first discovered by Killian in 1853. It usually involves the fourth and fifth lumbar vertebræ, although in many instances there is a congenital anomaly of the lumbosacral articulation which is potentially a weak joint, and trauma or disease is a contributing factor. The usual symptoms are back pain, radiating into the hips and legs, and aggravated by exercise, although cases have been observed in which there is practically no complaint of pain. Caudal lesions may occur, producing pain or paresthesia, and are usually limited to the fifth lumbar and first sacral nerves. Prominence of the sacrum, especially the upper edge, with a depression just above it is commonly noted. When the patient stands erect and the thumb is brought down along the spinous processes a depression is frequently found at the point of subluxation and if the thumb is pressed downward the bony prominence of the fifth lumbar vertebra or sacrum is plainly palpable. Forward movement is somewhat limited, and the patient is usually afraid to bend backward. A vaginal or rectal examination may disclose a prominent bony mass lying anterior to the sacrum due to the displaced vertebræ. In such cases the torso appears shortened, so that the margins of the rib may impinge on the ilium. Treatment consists of the application of a corset or a plaster-of-Paris cast, and surgical fusion of the lumbosacral articulation.

ENDOTHELIOMA OF THE FEMUR

Case VI.—A railroad engineer aged twenty-nine years had had pain in the right thigh radiating to the leg and foot for two years. An injury in the region of the right knee had been sustained seven years previously. A resulting abscess in the popliteal space was drained, and apparently there was no further difficulty. Hot packs and rest relieved the patient and he was free from symptoms for about three months when a second attack lasted a few days. During the next year similar attacks occurred, but he was never incapacitated. These attacks had been more frequent during the year preceding examination and hardly a month went by but that the patient had severe, hot, radiating pains in the leg. Swelling was noted in the anterior surface of the thigh, but there was no definite tenderness or redness. The pain was always worse at night and for several months the patient had been incapacitated and was losing weight. Roentgenograms, taken elsewhere, were reported negative.

The patient was 5 feet, 8 inches in height, weighing 124 pounds, which was about 16 pounds less than his usual weight. A swelling in the anterior surface of the right leg could be palpated. The mass was about 12.5 by 10 cm., fixed and firm, and seemed to involve the soft tissue. There was no soreness or redness. The swelling seemed to fluctuate in size and came on usually with pain. The joint-motions were normal. Prostatic examination was negative. The systolic blood pressure was 110 and the diastolic 50, and the temperature was normal. The Wassermann reaction on the blood and the urinalysis were negative. The hemoglobin was 72 per cent and the number of erythrocytes and leukocytes was normal. Polymorphonuclear leukocytes were 82 per cent. The roentgenologists reported tumor of the right femur, probably malignant. Roentgenograms of the chest, nasal sinuses, kidneys, ureters, and bladder were negative.

The surgeon suggested the possibility of endothelioma, and advised biopsy, which was performed September 30, 1927. The pathologists reported endothelioma. At operation, laminated-like areas of bone with tumor cells lying between

them and a large mass resembling a blood clot were found. Radiotherapy was advised, and three treatments of 200 kilovolts each were given. Following this the patient seemed greatly improved; he was free from pain and the swelling had subsided. He came back for observation in November, at which time he was given one treatment of 135 kilovolts. He stated that he wished to return to work.

Fig. 27.—(Case VI.) Endothelioma of the right femur. Layer-like formation of bone along the inner side of the femur, involving the shaft of the bone, with thickening of the cortex.

In January, 1928 the patient returned because of a sudden attack of pain in the shoulder. Since his last visit he had been having headaches, and pain in the shoulder. Roentgenograms of the pelvis, lumbar spine, and chest were negative. The roentgenologists diagnosed endothelioma of the right femur (Fig. 27). Metastasis was not demonstrated. In February and March the patient was given four treatments of 135 kilovolts

each, after which he returned home. In about three months he had a severe attack of pain, starting in the right shoulder, with some swelling in the anterior chest wall; the pain was referred to the right hip and abdomen. He was very nervous, had lost his appetite, and was troubled with insomnia. Roentgenograms showed destruction of the first lumbar vertebra apparently, and involvement of the twelfth rib. Roentgenograms of the chest were negative. The patient was given five treatments, each of 135 kilovolts, and following this he went home. Two months later he returned and his condition was apparently much improved, except for some pain in the left hip, radiating into the thigh and below the ribs. The pains which he had complained of previously were now absent. At this time he was given three treatments of 135 kilovolts each over the right femur, lower part of the thorax, and spine. He is still under observation.

The endothelioma reacted favorably to radiotherapy. It decreased in size and the pain disappeared, but there was recurrence, evidently with metastasis. The history of remissions from pain is typical of endothelioma. The roentgenograms showed onion-like layers of bone formation along the shaft of the femur. These manifestations are so typical that most endotheliomas can be correctly diagnosed without biopsy. Probably the most common mistake in diagnosis from the roentgenologic standpoint is that of osteomyelitis. I have seen patients operated on and pathologic examination of the tissue made when the true character of the tumor was unrecognized until after further surgical procedures and until changes in the bone had become so evident that one could hardly fail to recognize the fact that a tumor was present. Endotheliomas react to radiotherapy most favorably of any of the bone tumors, but although the pain is relieved and the tumor apparently disappears temporarily, metastasis usually takes place and ends fatally.

THE SIGNIFICANCE OF UREA

JESSE L. BOLLMAN AND FRANK C. MANN

To the surgeon the main practical significance of urea lies in the fact that its increase in the blood indicates retention due to decreased activity of the kidney. Among the many other aspects of interest in this substance may be mentioned its origin, the site of its formation, and the effect of its retention.

The significance of urea in nitrogenous metabolism was first established by Rouelle, in 1773, with the discovery of urea in the urine. Prévost and Dumas, in 1823, demonstrated the relation of the kidneys to the excretion of urea when they isolated urea from the blood after extirpation of the kidneys. The synthesis of urea from inorganic constituents by Wöhler, in 1828, may be regarded as the inception of organic chemistry and the beginning of biologic chemistry. It is not surprising, however, that urea should have been the first organic synthesis, since it is one of the least complex of the compounds which characterize living tissue. Urea has been found in the blood and fluids of all mammals, fish, amphibians, birds, and reptiles. It has also been found in starfish, crayfish, lobster, shrimp, oyster, mussel, snail, and some insects. It would appear that all animals which metabolize protein are capable of producing urea. The finding of urea in many plants increases the conviction that the formation of urea is closely connected to some fundamental process of all protein metabolism. This wide interpretation of the significance of urea is obviously too broad a subject to be discussed here. Accordingly we shall limit ourselves to a discussion of some of the facts concerning urea which we believe would be of more clinical interest.

The physical properties of urea which should be mentioned are its marked solubility and the fact that it exists in solution

as a simple solute which is readily diffusible through the ordinary membranes. These two physical properties account for several of its physiologic properties. As a waste product it is enabled to diffuse from the cells of its formation into the blood and body fluids and to filter readily through the glomeruli of the kidney to be excreted. The concentration of urea in the urine implies a specialized and selective barrier in the renal tubules which prevents the rapid reabsorption of urea and permits the rapid absorption of water and many of the other substances dissolved in the filtration fluid from the glomeruli. Because of these characteristics, urea is uniformly distributed throughout the body; the muscle and the various organs have approximately the same percentage of urea as is found in the blood. The kidneys contain more urea because of the concentrating effect of the tubules, and fat contains less urea because of the decreased amount of water in this tissue. Spinal pericardial, pleural, and peritoneal fluid also contain urea of approximately the same concentration as that of the blood. Bile, pancreatic juice, intestinal secretion, and saliva have the same urea content. The urea content of the saliva has been frequently utilized as an index of the urea content of the blood.

The chemical structure of urea has long been regarded as the diamide of carbonic acid, but Werner suggested that urea exists in a cyclic form which is easily opened by acids or alkalies to form an unsymmetrical isocarbamide. This view explains many of the chemical reactions of urea. Fearon listed seven methods by which urea can be formed: (1) Oxidation of proteins in alkaline solution; (2) oxidation of amino acids and their salts; (3) deamination of amino acids by hepatic perfusion; (4) oxidation of ammonia in the presence of hydrocarbon nuclei; (5) dehydration of ammonium carbonate and carbamate by hepatic perfusion; (6) dehydration of ammonium carbonate and carbamate by zymolysis, electrolysis, and irradiation; and (7) direct union of ammonia and ketocyanic acid.

The chemical reactions in all of these methods are similar in character and it would appear that some of them are responsible for the formation of urea in the body.

The widespread distribution of urea in nature would suggest that the ability to form urea would be characteristic of all living animal tissue. The same reasoning, however, could be applied to many other cellular activities which undoubtedly are present in the primitive cell, but due to the increased organization and specialization of life many of these activities are absent from the unspecialized tissue. This is noted in the case of the thyroid, parathyroid, and suprarenal glands, the pancreas, and other specialized tissue, and it would appear that the formation of urea is also specialized in the higher forms of life. Many investigations have been concerned with the site of formation of urea in the body. The methods used by the different investigators to determine the site have been varied, and diametrically opposite results have been obtained with each method by different investigators. The older chemical methods for the quantitative estimation of urea doubtless were sources of error, and even present-day methods do not distinguish minute amounts of urea. In many cases the physiologic methods used may be criticized even more severely than the chemical. Five different methods have been used: (1) Comparison of urea content of arterial and venous blood; (2) comparison of the urea content of tissues; (3) artificial perfusion and autolysis of excised tissue; (4) surgical removal of organs, and (5) clinical studies of hepatic disease. The first two methods have not been successful because the chemical methods available are not sufficiently accurate to detect the minute amount of urea which would be added to the blood at the instant it passes through any urea-forming organ. The extreme solubility and diffusibility of urea enable it to pass out of or into an organ by other channels, and the finding of increased amounts of urea in an organ would not mean that it was formed in that organ. The third method entails numerous technical difficulties, but has been employed to show that the liver is capable of transforming various ammonium compounds and several amino acids into urea. The fourth method presents mainly surgical difficulties which arise from the necessity of completely removing the liver from the circulation and in preserving the blood supply to the other organs. These objections

have been overcome in the method in which the liver may be removed surgically and the hepatectomized animal remains in good condition for twenty-four to forty hours afterward. The fifth method has indicated that the liver has a marked influence on the production of urea, but conclusions are difficult because of the fact that only a small amount of normal hepatic tissue will carry on the work of that organ and that few cases of hepatic disease are uncomplicated by disease in other parts of the body.

Removal of the liver from dogs is best accomplished in three stages. The first stage consists in a reverse Eck fistula; that is, lateral anastomosis of the portal vein and vena cava and ligation of the latter on the cephalic side of the stoma. At first, a considerable portion of the blood from the posterior part of the body passes through the liver, but since the capillaries of the liver offer more resistance to the flow of blood than is necessary for the development of collaterals through the azygos and internal mammary veins, most of the blood soon passes by way of the latter channels. The second stage consists in ligation of the portal vein at its entrance to the liver. This causes all the blood from the abdominal viscera and posterior portion of the body to return by way of the collateral vessels. The third stage consists in removing the entire liver. This is accomplished by removal of the liver intact with the portion of the vena cava which it surrounds, so that not even a trace of hepatic tissue remains in the animal. Recovery from the anesthesia and immediate effects of the operation is rapid. Within an hour the animal is, to all appearances, normal; it walks around, responds to call, and exhibits the usual interest in its surroundings. If the administration of glucose is continued the animal remains in this condition for twenty to forty hours.

Following hepatectomy there is a progressive decrease in the urea content of the blood and tissues, as well as a progressively decreasing amount of urea excreted in the urine.[2] Usually within eighteen to twenty-four hours the urea content of the blood and urine is at extremely minimal values. The total amount of urea excreted in the urine is only that which repre-

sents the amount of urea present in the blood and tissues at the time of operation, and has been washed into the urine. If urine is not secreted following hepatectomy, either because of anuria or bilateral nephrectomy, increase is not obtained in the urea content of the blood and tissues over a period of time which would allow the urea content of the blood and tissues to more than double in anuric animals with intact livers. Hepatectomy performed in nephrectomized animals at a time when the urea content of the blood and tissues is rapidly increasing brings about complete cessation of the increase. The injection of amino acids or ammonium salts into normal animals gives rise to a marked increase in the formation of urea, but these substances are not converted into urea in the dehepatized dog. We believe that this evidence is conclusive proof that the production of urea in the dog is entirely dependent on the presence of the liver.

The means of eliminating urea from the body other than by way of the kidney are extremely limited. Since the excretion of urea is dependent on the function of the glomeruli of the kidney, definite retention of urea in the blood is an indication of either primary or secondary impairment of the glomeruli. There are a few conditions in which great increases in the urea content of the blood are not accompanied by demonstrable changes in the kidney, but which represent increased formation of urea due to definite toxic influences. The other avenues of elimination of urea from the body depend on the fact that urea is present in all of the body fluids, so that if the content is high, considerable urea may be eliminated by perspiration, catharsis, or emesis. Retention of urea in the blood is usually a reliable index of the severity of the toxic syndrome called uremia, but the toxicity does not depend on the retained urea, since this substance has frequently been shown to be relatively nontoxic.

We have performed some experiments which illustrate quite clearly that urea is not responsible for the symptoms of uremia.[1] Following the transplantation of the ureters into the duodenum, jejunum, or ileum all of the urine drains into the intestine. The fluid of the urine was all reabsorbed and the animals continued to pass well formed stools. For the first five to seven days there

was a rapid rise in the urea content of the blood without appreciable changes in the creatinin, creatin, uric acid, or amino acid content of the blood. This fact illustrates well the extreme diffusibility of urea. The subsequent course of the blood urea was also interesting as it continued to rise for several days. In some cases extremely high values for the urea content of the blood were obtained, these ranging from 1,500 to 1,800 mg. urea for each 100 c.c. of blood. This great amount of urea did not appear toxic to these animals as they appeared in good condition and maintained their normal appetite. From fourteen to twenty days after operation symptoms like those of uremia appeared; vomiting, diarrhea, lassitude, coma, and death followed. With the onset of symptoms the urea content of the blood was found to decrease rapidly, due to the loss of urea from the body in the fluid of the vomitus and feces. This decrease, however, did not affect the symptoms which progressed until the animals died, usually fifteen to twenty-four days after operation.

Urea is an ideal waste product because it is stable and inert, and provides an extremely soluble substance in which nitrogen can be eliminated. It is also an ideal substance to act as a buffer, capable of neutralizing acids and ammonia. The low urea values of the blood, urine, and tissues following hepatectomy have afforded interesting data with reference to the formation of ammonia. It is common knowledge that the ammonia content of the urine is greatly increased following the administration of acids, and reduced following alkalies. The liver is not primarily concerned with the formation of ammonia since these same changes occur following its removal. The formation of ammonia is greatly diminished and it is frequently almost entirely absent from the urine of hepatectomized animals when the urea content of the blood and tissues has decreased so that only traces of urea are found in the urine. Proof that urea is a definite precursor of this ammonia is found in the fact that the administration of urea restores the excretion of ammonia.

Increased formation of urea in the body may be accomplished in several ways, but all seem dependent on increased metabolism or destruction of protein. The increase of protein in the diet is

followed by increased excretion of urea so that except under special conditions the entire additional nitrogen is excreted within two days. Amino acids and ammonium salts are also rapidly converted to urea. The excess wasting of body protein in fever gives rise to excess urea formation. Severe diabetes is often accompanied by increased urea formation because of the utilization of protein in place of the carbohydrate which is not available for use. The rapid reduction of body weight by thyroxin, or the removal of ascitic fluid by diuretics, is accompanied by an increase in the amount of urea excreted. This seems to be due to the fact that the water removed by such measures is combined with protein which must also be removed, and urea is formed by the breakdown of this protein. Urea formation is also frequently increased in cases of high intestinal obstruction, acute duodenal fistula, and complete pancreatic fistula. In each condition loss of fluid (dehydration) is often a prominent feature. In view of the fact that urea does not increase if these subjects are given quantities of fluid, it would appear that this increase may also be connected with the reduction of the water in the tissues.

Reduction of urea formation is accomplished by reduction of the protein content of the diet. With starvation, the elimination of urea is reduced rapidly, but does not reach a minimal level; it can be further reduced by a diet of carbohydrates, but the formation of urea cannot be entirely eliminated. Complete removal of the liver is the only means of producing complete cessation of urea formation.

BIBLIOGRAPHY

1. Bollman, J. L. and Mann, F. C.: Nitrogenous constitutents of blood following transplantation of ureters into different levels of intestine. Proc. Soc. Exper. Biol. and Med., 1927, xxiv, 923–924.

2. Bollman, J. L., Mann, F. C., and Magath, T. B.: Studies on the physiology of the liver. VIII. Effect of total removal of the liver on the formation of urea. Am. Jour. Physiol., 1924, lxix, 371–392.

3. Fearon, W. R.: The biochemistry of urea. Physiol. Rev., 1926, vi, 399–439.

4. Mann, F. C.: Studies in the physiology of the liver: I. Technic and general effects of removal. Am. Jour. Med. Sc., 1921, clxi, 37–42.

5. Prévost, J. L., and Dumas, J. B.: Examen du sang et de son action dans les divers phénomènes de la vie. Ann. de chim. et de phys., 1823, xxiii, 50–69, 90–104.

6. Rouelle, F. M.: Quoted by Fearon.

7. Werner, E. A.: The chemistry of urea. London, Longmans, Greene and Co., 1923, 199 pp.

8. Wöhler, F.: Quoted by Fearon.

THE PHAGOCYTIC CELLS OF THE MAMMALIAN LIVER

GEORGE M. HIGGINS AND FRANK C. MANN

THERE are few phases of general physiologic activity of more importance to the surgeon than that which is concerned with the mechanism whereby the body is protected from infection.

Cellular defense against foreign invasion within the body is largely a function of the free wandering cells distributed throughout the various tissues. Besides these free cells, a fixed or stationary group, including the reticular cells of the spleen, the lymph nodes, and bone marrow, are actively phagocytic toward free-moving particles in the blood stream. Aschoff employed the compound term, reticulo-endothelial, to describe this system including both wandering and stationary cells which have been shown to possess marked phagocytic reaction to injected vital dyes. Evans has used the term "macrophage system" to include these same cells, and many investigators regard this designation a better one, for it is not at all certain that all such wandering cells are of endothelial origin.

With the advance of animal experimentation the known functions of this reticulo-endothelial or macrophage system are constantly increasing. The free-moving tissue histocytes may readily phagocytose blood cells, bacteria, or foreign bodies mechanically introduced into the body. The large blood histocytes may phagocytose foreign pigment, metamorphose into fibroblasts, and form connective-tissue elements in the development of granulation tissue. In various pathologic states they have been known to increase markedly in number, thus serving as an adequate mechanism for defense. The reticular cells of the sinuses and certain highly specialized endothelial cells are sufficiently phagocytic to clear the circulation in eight to ten minutes following the intravenous injection of a few cubic

centimeters of graphite suspension. Furthermore, the cells comprising the system are of extreme significance in certain normal physiologic processes. The formation of bile pigment, for example, has been shown to be a function of these cells which line the sinuses of the bone marrow and the spleen. The stellate cells of the liver comprise the only hepatic portion of the reticulo-endothelial system. These cells, distributed along the vascular sinusoids of the hepatic lobule, which so readily engulf foreign particles from the blood stream as they pass along, are known throughout the literature as the cells of von Kupffer.[4] Ponfick is credited with the earliest recognition of these phagocytic cells and yet, because of the extensive studies of von Kupffer[5] and his complete publication in 1899, these cells continue to bear his name. The exact site of these cells, or their origin and fate are by no means established even at the present time. Von Kupffer's final conclusions were that these cells are not perivascular, as he originally supposed; but rather, they are definitely a part of the endothelium which lines the portal branches. Since then conflicting as well as supporting opinions have been advanced concerning the position and the nature of these cells. Considerable experimental evidence has been submitted which gives an entirely independent origin to the phagocytic stellate cells.

Lewis recognized, in tissue culture studies, a striking resemblance between the von Kupffer cell of the liver and mononuclear leukocytes of the blood stream. Accordingly the endothelial origin of these cells is by no means completely established; and it seems entirely certain that all endothelial cells of the liver are not potentially phagocytic. However, Pfühl, in 1926, in the last published data on the morphology of the von Kupffer cells, identified them as endothelial cells and differentiated them on the basis of their activity into a "seizing" and a digesting type. The former, projecting somewhat into the lumen of the blood stream, are actively phagocytic and take positions best adapted to their function; the latter are less attenuated and lie embedded within the endothelium.

In the more or less casual survey of a section of an hepatic lobule, stained as a routine with hematoxylin and eosin, one

gains only an inadequate and incorrect concept of the extent and relationships of the stellate cell. Various injecting mediums, iron stains, and colloidal silver have been extensively employed to delineate these cells, all with varying degrees of success. Within the last few months, a method more satisfactory than any hitherto employed has been developed in this laboratory; it provides a means for the study of these cells in normal physiologic states as well as in pathologic states. The details of the method together with a study of the morphologic relations of von Kupffer cells in the common laboratory animals are now available.[3] In brief the method consists of the intravenous injection of a few cubic centimeters of a finely particulate graphite suspension. The particular suspension employed is highly desirable in the sense that it does not agglutinate in the presence of the body serums, as is true of India ink and other graphite suspensions. The final preparation is composed of particles evenly distributed throughout an acacia matrix, many times smaller than erythrocytes. If a few cubic centimeters of the preparation are injected slowly into the blood stream the animal rarely, if ever, suffers any reaction. The liver becomes black immediately and microscopic study of such sections shows the lobule abundantly studded with heavily pigmented cells of various shapes and sizes along the endothelium lining the sinusoids. Their stellate appearance is by no means constant, since oval cells or elongate cells, with greatly attenuated processes, are not infrequent. Occasionally, however, one encounters cells which possess processes somewhat radially arranged around the cell body, cells which induced von Kupffer to designate them as the star cells.

There does not appear to be any actual regularity in the distribution of these cells throughout the hepatic lobule. They do not appear to be restricted to any particular level of the lobule, but are equally conspicuous either at the periphery or along the central axis. Furthermore, they are not visible in all sinusoids, a fact which lends some support to the nonendothelial nature of these phagocytic cells. In these numerous sinusoids, apparently devoid of any phagocytic cells, typical endothelial

cells lining the capillaries abound, and the question presents itself as to the relative potential phagocytic capacity of these endothelial cells. The suggestion has been made that these cells are intermittently active. Only certain of them function at any one time, so that following a single injection of the graphite suspension all functional stellate cells would not necessarily be visible. A study of any graphite-stained liver will convince one that the cellular elements of the capillary wall are not identical. Certain of them are larger, possess clear nuclei and, as we have stated, project far into the lumen. These are the von Kupffer cells and, as may be readily recognized, they usually are identified at the confluence of capillaries or at crests where they can best discharge their function. The remaining elements of the capillary wall constitute the true hepatic endothelium, and in these cells we have never been able to demonstrate any graphite inclusions following intravenous injection. Although these marked differentiations do occur, certain authors do not regard them as sufficient to warrant any separation into two distinct categories of cells. Maximow and others regard the common hepatic endothelial cell as being potentially phagocytic and that following increased injections of colloidal silver or some colloidal foreign substance many more hitherto inactive cells become phagocytic. Maximow stated that under such conditions practically all of the cytologic elements of the capillary wall may assume properties of von Kupffer cells or even transform into free and independent macrophages. With this in mind Murphy and one of us (Higgins) were prompted to carry out a series of experiments on rabbits, which involved the daily injection of gradually increasing quantities of the graphite suspension. Sections of livers taken from rabbits which had received daily injections of 5, 6, or 7 c.c. of the graphite suspension did not reveal any appreciably greater response on the part of the stellate cells than was evident following a single injection. Furthermore, the endothelial cells which line the sinusoids of the lobule have failed to phagocytose the pigment, but continue to serve the purpose of the normal vascular endothelial cell. Accordingly we do not have any evidence to support the con-

tention that hepatic endothelium is potentially phagocytic and that under peculiar conditions of stress or strain may give rise to functionally active von Kupffer cells.

The extent to which phagocytic cells so frequently project into the lumen of the blood sinusoid suggests, at least, that perhaps they may not be of hepatogenous origin. Their attachment to the wall of the sinusoid is often by such a restricted surface that one gains the impression that they are but temporarily sessile on hepatic endothelium, and that they may from time to time become detached and continue as blood cells within the circulatory system. Occasionally such cells, identical in every way with those found on the sinusoidal wall, appear free in the hepatic capillaries and one must admit a similarity to mononuclear leukocytes. To be sure, any method of examining sections of tissue does not render adequate proof of cytologic relationships and perhaps no method, outside of tissue culture, can ever establish the exact lineage between monocytes of the blood stream and the von Kupffer cells of the liver. As a matter of fact such cultures of isolated hepatic tissue have shown that von Kupffer cells may transform into mobilized and ameboid polyblasts. Furthermore, in certain pathologic states, for example in specific inflammation of the liver, these special cells hypertrophy, increase extensively in number, become detached from the sinusoid and become free histocytes or macrophages. In all probability, at least one source of normal blood histocytes is the liver, although the sinuses of the spleen, the lymph nodes, and bone marrow are no doubt more prolific sources. There have been some observations, the results of which ascribe to the wall of the hepatic capillaries a hematopoietic as well as a histocytic capacity. In this event the von Kupffer cells are essentially blood cells.

The fate of the von Kupffer cells of the liver as well as the normal histocytes of the various body tissues is but little understood. Under abnormal physiologic or stimulating pathologic states the fixed phagocytic cells may be isolated and become free macrophages. Numerous authors have shown that in experimental animals repeatedly injected with colloidal suspensions

that such fixed cells may enter the blood stream and pass through the venous circulation to the lung. The distribution of these histocytes within the lung is not clear. In certain experimental observations these phagocytes seem to become incorporated in the wall of the pulmonary veins, but only occasional ones pass into the circulation. In our experimental observations on rabbits made several weeks following literal packing of the phagocytic cells of the liver, we have not recognized any definite degree of distribution of the particulate graphite in the lung.

BIBLIOGRAPHY

1. Aschoff, L.: Das reticulo-endotheliale System. Ergbz. d. inn. Med. u. Kinderh., 1924, xxvi, 1–118.

2. Evans, H. M.: The macrophages of mammals. Am. Jour. Phys., 1915, xxvii, 243–258.

3. Higgins, G. M., and Murphy, G. T.: The phagocytic cells (v. Kupffer) in the liver of common laboratory animals. Anat. Rec., 1928, xl, 15–39.

4. v. Kupffer, C.: Ueber Sternzellen der Leber. Briefliche Mittheilung an Prof. Waldeyer. Arch. f. mikr. Anat., 1876, xii, 353–358.

5. v. Kupffer, C.: Ueber die sogenannten Sternzellen der Säugethierleber. Arch. f. mikr. Anat., 1899, liv, 254–288.

6. Lewis, M. R.: The resemblance between the Kupffer cells and the mononuclear leukocyte of the frog studied in vitro. Anat. Rec., 1925, xxix, 390.

7. Maximow, A. A.: The macrophages or histiocytes. In: Cowdry, E. V.: Special cytology, New York, P. B. Hoeber, 1928, i, pp. 425–484.

8. Pfühl, Wilhelm: Experimentelle Untersuchungen über die Kupfferschen Sternzellen der Leber. I. Mitteilung: die verschiedenen Formen der Sternzellen, ihre Lage in den Lebercapillaren, und ihre allgemeine Biologie. Ztschr. f. Anat. u. Entwickl., 1926, lxxxi, 90–114.

9. Ponfick, E.: Studien über die Schicksale körniger Farbstoffe im Organismus. Arch. f. Path. Anat. u. Physiol, 1869, xlviii, 1–55.

POSTOPERATIVE ABDOMINAL SINUSES

WALTER E. SISTRUNK

A CASE OF UNKNOWN ETIOLOGY

Case I.—A married woman aged thirty-seven years came for consultation in September, 1925. Appendectomy had been performed elsewhere in 1924 during an interval between acute attacks; the abdomen was closed without drainage. Forty-eight hours after the operation the wound became indurated and red, and four or five days later began to discharge pus. The infection did not respond to ordinary methods of treatment, although the patient was kept in hospital for ten weeks. During this time the infection tended to burrow into the subcutaneous tissues between the skin and the fascia covering the muscles, and it was necessary to drain pus pockets which formed. The sinuses could not be made to heal. Numerous operations were performed elsewhere for drainage of the sinus tracts and of localized collections of pus.

On the patient's first visit to the Clinic the abdomen was opened and a right ovarian cyst, about 7 cm. in diameter, and the right fallopian tube were removed. Immediately preceding this operation the sinuses were injected with methylene blue, but this dye could not be found in the abdominal cavity at operation so it was believed that the infection was probably entirely extraperitoneal. Later at various times sinuses were opened and drained. Repeated pathologic and bacteriologic studies were made from tissues and cultures taken at each of the operations. At times hemolytic streptococci and staphylococci could be grown in the cultures. Inoculations with pus from the sinuses failed to produce tuberculosis or characteristic lesions in guinea-pigs. Repeated smears failed to show the presence of actinomycosis. Examinations for blastomycosis were also negative. The spread of the infection since its beginning had been slow

but progressive and unassociated with grave toxemia or high fever except at the onset when the patient had a septic fever and chills. After various types of treatments had been used the patient was allowed to return home, but she has returned to the Clinic on several occasions since for examination. From the beginning the burrowing subcutaneous infection has persisted, and localized areas containing odorless, yellow pus, situated at times some distance from the sinus opening, have developed. There has not been any tendency for the infection to involve the skin.

At the patient's most recent visit sinus tracts were found which extended from the crest of the ilium on one side to that on the opposite side. Roentgen-ray examinations of the pelvic bones were negative. The leukocytes numbered 10,000 and the erythrocytes 3,450,000; the hemoglobin was 59 per cent.

Grossly the sinus tracts after being opened resembled closely those seen in tuberculosis. The granulation tissue scraped from the walls of the tracts was pale and edematous. Many microscopic sections of this tissue and of the walls of the sinus tracts were examined by the pathologists; some of these sections suggested tuberculosis and an occasional foreign-body giant-cell was found, but the evidences were insufficient to permit a diagnosis of tuberculosis. Guinea-pig inoculations failed, as they had on previous occasions, to produce tuberculosis.

The sinus tracts were widely opened and all of these seemed to communicate with a single tract situated in the median line just above the pubic bone. This tract was much deeper than the others and could be followed down for a distance of several centimeters underneath the pubic bone.

As yet a definite etiologic factor has not been determined in this case and it has been looked on as an anaërobic type of infection probably caused by one or more unknown organisms. I have been at a loss to know just how to deal further with the case, since the sinus tracts have been repeatedly opened and various types of treatment used. It was finally suggested that the patient go to the southwest portion of the United States, and that heliotherapy be used over a period of two or three years.

Abdominal sinuses are fairly common. They are usually caused by foreign bodies, such as rubber tubes, gauze, silk ligatures, or fecal concretions left in the abdominal cavity following operations for acute, perforating, gangrenous appendicitis. Such sinuses may extend only to the deeper tissues of the abdominal wall or may extend into the peritoneal cavity. Sinuses are also seen that are caused by tuberculosis, by actinomycosis, and occasionally by colloid carcinoma and blastomycosis. Abdominal sinuses may also occur following certain pelvic operations, and in many of these the tracts are found to lead down to an infected ovary or tube. Sinuses of the foregoing type are often associated with an area of deep-seated induration, but the infection does not tend to burrow through the subcutaneous tissues as occurred in this case.

Cullen, in a paper read before the Southern Surgical Association in 1924, reported a case somewhat similar to the one reported here in which the condition developed following drainage of an abdominal abscess. The wound was drained at operation. Two days after the operation the tissues surrounding the incision became red and indurated. Progressive destruction of the skin and subcutaneous tissues developed and resulted in a wide ulcerating area. The only organism found in this case was *Streptococcus brevis*. The condition was finally cured by wide excision of the diseased area and later skin grafting.

Brewer, in a paper read before the American Surgical Association in 1926, reported two cases of his own and several others which had been brought to his attention of extensive destruction of the skin and subcutaneous tissues from an unusual infection. His own cases had followed operations for perforated appendicitis. One of these was successfully cured by wide excision of the infected area and the other by making an elliptical incision around the infected area and packing the wound with gauze soaked in 1 per cent formalin. Bacteriologic studies in one of these cases showed *Staphylococcus aureus*, an anaërobic streptococcus, and a diphtheroid bacillus. Lesions quite similar to those present in the patient were produced in animals by subcutaneous inoculations with the staphylococcus and strep-

tococcus found, in combination. Injection of either of these organisms alone did not produce the characteristic lesion.

An occasional case of superficial destruction of the skin is seen caused by an amebic infection of the skin.

SINUSES CAUSED BY ACTINOMYCOSIS

Case II.—A married woman aged thirty-seven years came to The Mayo Clinic complaining of draining sinuses situated in the lower abdominal wall on the right side. The trouble began following appendectomy for acute purulent, unruptured appendicitis performed elsewhere eighteen months previously. The incision was closed without drainage. Three days after operation a stitch abscess developed. The wound drained for four or five weeks and then healed. Abscesses then began to develop below and to the right of the incision. When these ruptured, dark-colored material drained from the openings and later pus. The sinuses failed to heal and new abscesses continued to appear. Twelve weeks following operation for appendicitis both fallopian tubes were removed elsewhere through a low median-line incision. It was believed that the tubes had been responsible for the formation of the abscesses. The incision following this operation healed promptly, but did not cause the sinuses to heal. Many methods of treatment were used. Several possible foci of infection were removed. Bismuth was injected into the sinus tracts; and lights of various kinds and an autogenous vaccine were used without benefit.

General examination on admission was negative except for several sinuses low on the right side of the abdominal wall. There was also a fluctuating mass close to the crest of the ilium and pressure over this mass caused pus to exude from three of the sinus tracts. Small, yellow flakes (sulphur bodies) could be easily seen in this pus which on microscopic examination showed the presence of actinomyces.

The case resembled Case I quite closely except for the presence of sulphur bodies, and the microscopic examination of these made the diagnosis clear.

Cases of actinomycosis are often seen. New and Figi re-

ported, several years ago, about 185 cases which had come under their care in The Mayo Clinic. The disease probably affects patients through ingestion of the actinomyces and is often seen in persons who come in close contact with cattle and in those who have a habit of chewing grass and straw.

In an article published a few years ago, New and Figi stated that 68 per cent of the group of cases which they reported had occurred around the head and neck, 22 per cent in the abdomen or pelvis, 7 per cent in the thorax, and 2 per cent in the lower extremities.

The intra-abdominal type of actinomycosis is difficult to cure on account of the inability of the surgeon satisfactorily to open and drain the sinus tracts. The sinuses usually follow exploration of a tumor in the region of the cecum which is often mistaken for a ruptured appendix. Sinuses also apparently may follow simple appendectomy during which the wound, no doubt, is contaminated by feces containing actinomyces. As the fungus is anaërobic in type, the infection tends to burrow through the subcutaneous and deeper tissues and produces distant abscesses. The intra-abdominal type is more often seen than the types in which the subcutaneous tissues of the abdominal wall alone are involved. In the intra-abdominal type the infection usually spreads into the pelvis or into the tissues around the kidney and liver. Infections situated around the head and neck probably begin in the pharynx or tongue and extend downward into the neck. From either the intra-abdominal infection or the infection around the head and neck, the disease may eventually involve the thorax. Death usually occurs after the actinomyces have invaded either the thorax or the cranial cavity.

The best results from treatment have been obtained by opening all the sinus tracts widely, swabbing them with tincture of iodin, and then packing them with iodoform gauze. This gauze is left undisturbed for eight or ten days to prevent closure of the tracts after it has been removed. Roentgen-ray exposures in doses similar to those used in treating malignant disease seem to be of considerable value, probably by directly affecting

the growth of the actinomyces and by breaking down indurated tissues. The administration of iodin in large doses is also important. The usual dose is 10 drops of saturated solution of potassium iodid, well diluted, three times a day after meals. If such medication is tolerated, the dose is increased 5 drops each dose, each day until a maximum of 200 drops three times a day is given. The iodid is then discontinued for a period of about two weeks when it is again used in doses of 10 drops three times a day as before and increased until the dose of 200 drops three times a day is reached. The area of infection is carefully watched for the formation of new abscesses which are widely opened and drained if they should occur.

The diagnosis may often be suspected clinically through the observation of the typical sulphur bodies in the pus and may be made with certainty by examination of the sulphur bodies microscopically. Fortunately the infection in this case apparently was not intra-abdominal and involved only the superficial tissues of the abdominal wall. The results of treatment were excellent; although it was necessary to open one abscess pocket which developed following the first operation, all of the sinus tracts healed promptly and have remained healed for six months.

CASES FROM THE CLINIC OF GORDON B. NEW

GORDON B. NEW

RECONSTRUCTION OF UPPER LIP AND PORTION OF NOSE

Case I.—A married woman aged fifty years came to the Clinic February 1, 1924, because of a recurring growth of the right upper lip and lower portion of the nostril, of twenty-five years' duration. The trouble had started as a warty growth on the margin of the right nostril. It grew very slightly for five years and then roentgen-ray treatment was used. The lesion recurred in three years and a plaster was applied. Later, the condition recurred again and roentgen-ray treatments were given every few years until two years previously when radium needles were inserted all through the growth. In the last two years the lesion had spread into the upper lip.

Examination revealed a recurring epithelioma of the lower portion of the nose which involved the right ala, the columella, the floor of both nostrils, and the upper lip in its middle two-thirds. The periosteum of the anterior surface of the upper jaw was involved in the growth.

February 4, the growth was excised with the cutting cautery and the base was destroyed with a soldering iron. The growth was shown microscopically to be a squamous-cell epithelioma, graded 3. Recovery was uneventful, and July 31, 1924 a sequestrum was removed from the upper jaw.

The patient returned July 28, 1927 for reconstruction of the upper lip and nose (Fig. 28). There was loss of the greater part of the right ala, the columella, the anterior portion of the upper jaw above the alveolar process, and the middle two-thirds of the upper lip. There was no recurrence of the growth. A flap with a pedicle in the left temporal region was elevated from the forehead. The distal third was lined with a full-thickness

skin graft taken from inside the left arm. A distal pedicle was left in order to assure the blood supply. In a week the distal pedicle was cut across, and in stages the flap was elevated from the forehead and was brought down in position to fill in the lost portion of the upper lip. A full-thickness skin graft was used to fill in the area on the forehead. After healing of the attachment of the distal end of the flap to the right upper lip had progressed well, the rest of the lip was filled in with the flap. The distal portion of the flap was used to fill in the colu-

FIG. 28.—(Case I.) Appearance of patient following removal of epithelioma of the nose and upper lip; partial loss of the right ala and upper lip.

mella and the lost part of the right ala of the nose. This was accomplished by splitting the flap and the operation was done in multiple stages. The remaining portion of the flap was returned to the forehead. The patient returned about six months from the time of the operations for the further plastic work of shaping the upper lip and the right ala. A photograph taken June 12, 1928, shows the patient following completion of the operative work (Fig. 29). The right ala, which was

constructed from the distal end of the flap is seen. The columella does not show in this photograph. The patient made the vermilion margins of the lips herself with cosmetics.

This case is interesting on account of its long history. For twenty-five years the patient had an epithelioma of the nose which secondarily involved the upper lip and the jaw. The lesion probably was a low-grade basal-cell epithelioma which

FIG. 29.—(Case I.) Appearance of patient following plastic reconstruction. The patient made the vermilion margins of the lips with cosmetics.

was held in check with roentgen ray and radium. At the time of its removal, the lesion was a squamous-cell epithelioma, graded 3; this demonstrates that an epithelioma may change its character and in time may become active if the treatment does not entirely clear it up. On account of the involvement of bone, diathermy or the cautery is preferable to radium or roentgen ray.

After waiting a sufficient length of time to be reasonably sure that the epithelioma would not recur, the lip was reconstructed by means of a flap from the forehead with a pedicle in the temporal region. The columella and the right ala of the

nose were formed by using the distal end of the flap, splitting it, and rotating it up to the nose after the lip had been constructed.

CAVERNOUS HEMANGIOMA IN THE ADULT

Case II.—A youth aged seventeen years came to the Clinic July 23, 1919, on account of a large mass in the right temporal region. This first had been noticed four years previously. The temporal artery had been ligated by the patient's home physician six weeks previously. The tumor had grown considerably since that time.

The patient presented a mass in the right temporal region which involved the right cheek and the upper and lower eyelids. It was about 8 cm. in diameter and stood out from the forehead about 5 cm. The condition appeared to be a cavernous hemangioma except that it was more active and pulsated slightly.

August 6, 1919, radium was inserted directly into the tumor, and was left in place twelve hours; the dose was 50 milligram hours. This treatment was repeated on four occasions between August 6, 1919 and February 11, 1920. Radium treatment was used outside the temporal region; the dose was 3,000 milligram hours with 2 mm. of lead and 1 inch of wood screening. This treatment was repeated from time to time with marked reduction in the size of the tumor. April 21, 1920, the scarred mass in the right temporal and frontal regions, the result of the treatment of the cavernous hemangioma, was removed. July 7, 1921, a scar was excised from the right temporal and frontal regions along with a mass of vascular and scar tissue (Fig. 30). Figure 31 shows the patient following the treatment.

In the treatment of cavernous angioma in children, radium is satisfactory. It may be inserted directly into the center of the tumor, by opening into the tumor as one would open into a blister, with entrance through the normal skin. In adults, however, the method is very slow, although a good result ultimately may be obtained. Surgical diathermy used by means of a protected point is a much safer and a much more satisfactory method.

This case shows the result of the insertion of radium directly

FIG. 30.—(Case II.) Cavernous hemangioma of the right temporal region with some pulsation.

FIG. 31.—(Case II.) Appearance of patient following treatment.

into the tumor and later excision of the angiomatous tissue and the scarred mass.

ADAMANTINOMA OF THE LOWER JAW TREATED WITH SURGICAL DIATHERMY

Case III.—A woman aged twenty-four years came to the Clinic August 3, 1927, because of a tumor of the right lower jaw at the angle. The patient stated that she had had a wisdom tooth removed a year previously, that the wound had not healed and that it still discharged material at times. Within the last six months the tumor had seemed to be growing larger.

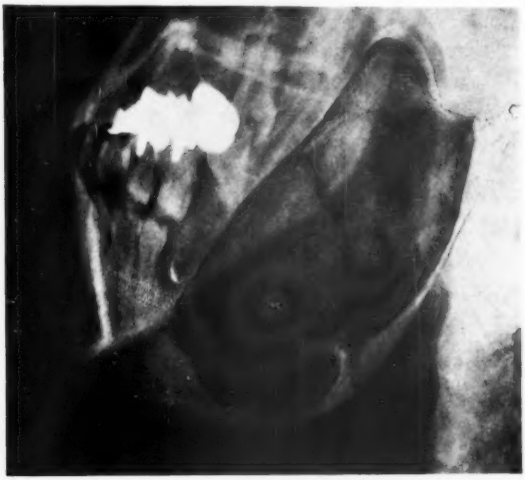


FIG. 32.—(Case III.) Retouched roentgenogram showing extensive adamantinoma of the lower jaw, with extensive destruction of the body of the left lower jaw and ascending ramus.

Examination externally revealed a mass in the region of the angle of the jaw and the cheek was bulged over an area about 7 cm. in diameter. Inside the mouth at the right angle of the jaw, there was a bulging, cystic mass 6 cm. in diameter. A discharging sinus was not present.

A roentgen-ray examination of the right lower jaw, at the

angle, revealed a multilocular cystic mass extending from the second bicuspid tooth to the coronoid process and destroying almost the entire body of the jaw except for a narrow margin posteriorly, and a very thin wall of bone anteriorly (Fig. 32). General examination of the patient did not show anything of note.

August 9, 1927, exploratory operation was performed from inside the mouth. An extensive adamantinoma was found.

FIG. 33.—(Case III.) Retouched roentgenogram showing regeneration of the bone in the body and the ascending ramus of the lower jaw.

There were many solid and cystic areas throughout the tumor. Only a thin shell of bone was present posteriorly. Surgical diathermy was used in order to destroy the tumor. Microscopically, it was shown to be an adamantinoma. Recovery was uneventful.

November 17, 1927, a small recurrent adamantinoma, just at the angle on the jaw, was destroyed with diathermy. The patient returned March 15, 1928, and a sequestrum was removed from the angle. What appeared to be the bony shell-like wall of the cyst came away as sequestrum at that time.

The patient again returned June 19, 1928, in excellent general condition and a roentgenogram (Fig. 33) showed remarkable regeneration of the lower jaw. The patient has not had further trouble since that time. The jaw functions well.

This patient, twenty-four years of age, was younger than the average patient with an adamantinoma of the lower jaw. The age at which this type of tumor usually occurs is between twenty-five and thirty years.[2] It usually occurs in the lower jaw, at the angle. It may occur, although rarely, in the upper jaw. These tumors are multilocular cysts, sometimes called adamantine epitheliomas, and they usually occur in the manner of tumors of a low-grade of malignancy. Some, however, are quite active and I have seen one case that produced the death of the patient by its rapid growth; in a second case, the tumor, of very cellular type, metastasized into the submaxillary glands. This patient, however, is still alive and two years have elapsed since the time of removal of the glands and the destruction of the local tumor with surgical diathermy.

Surgical diathermy has been found to be the method of choice at the Mayo Clinic in the treatment of these tumors, as it destroys the tumor and gives the remaining bone the opportunity to form new bone; in this way, it saves, in some cases, the necessity of a bone transplant.

FIBROMA OF THE LARYNX

Case IV.—A man aged twenty-five years came to the Clinic August 29, 1927. For eight years he had noticed that he was unable to talk plainly, and that he had had some difficulty in swallowing because of something that he felt was in his throat. He had not had pain nor did he have any other complaint. He had consulted a physician a few weeks previously who had referred him to the Clinic for treatment.

Examination revealed a large, hard tumor almost completely filling the hypopharynx and attached to the posterior surface of the epiglottis over its entire area. The mucous membrane was not ulcerated and the growth appeared clinically like a fibroma (Fig. 34).

September 2, 1927, low tracheotomy was performed behind the isthmus of the thyroid as it was not thought advisable to attempt to remove the laryngeal tumor without tracheotomy. September 14, the patient again was operated on by means of suspension laryngoscopy under ether anesthesia. The intralaryngeal structures or the lower half of the posterior wall of the hypopharynx could not be seen. Biopsy was carried out which showed the tumor to be a fibroma. The lesion was partially destroyed with diathermy. October 24, 1927, under suspension laryngoscopy, further destruction of the tumor with diathermy was done.

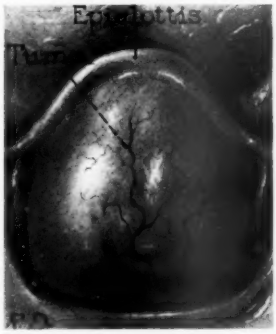


FIG. 34.—(Case IV.) Fibroma of the larynx attached to the posterior surface of the epiglottis.

November 7, 1927, the tracheotomy tube was removed and the patient has made an uneventful recovery. There was a small area at the base of the epiglottis which, it was recognized, might have to be treated later. The vocal cords were not injured and the tumor was entirely above the intralaryngeal structures.

August 31, 1928, the small area at the base of the epiglottis, which had not been removed previously, was removed with diathermy. The patient has not had further trouble.

Fibroma of the larynx is one of the most common of benign tumors. In 1916, I reported a case of fibrolipoma of the larynx and its removal by means of thyrotomy. The tumor in the

case reported here, however, is the largest fibroma of the epiglottis that I ever have seen. A similar case was reported by Chappell in 1907. On account of the size of the tumor, which almost completely filled the hypopharynx, it was not advisable to attempt removal without preliminary tracheotomy. The tumor might have been removed by means of pharyngotomy, but the use of surgical diathermy was the treatment instituted as it is in this type of case that such treatment is indicated.

EXTRINSIC EPITHELIOMA OF THE LARYNX

Case V.—A man aged fifty-three years came for examination August 15, 1928, complaining of soreness of the throat and dysphagia with some hoarseness. These symptoms had been present for six or eight months. The trouble started with some coughing when he swallowed, and gargles were given for this. He complained of some pain in the right ear. Six weeks previously he had consulted a physician who had made a diagnosis of epithelioma and had referred the patient to the Clinic for treatment. The patient's general health was good. He had not lost weight.

Examination revealed an extrinsic epithelioma of the right side of the larynx, involving the right half of the epiglottis, the true and false cord, extending to the pyriform fossa, and involving the right arytenoid as far as one could see into the upper end of the esophagus. The lymph nodes were not involved. Microscopically, the lesion was shown to be a squamous-cell epithelioma, graded 3.

A diagnosis of extrinsic carcinoma of the larynx was made. Laryngectomy was recommended since it was the only treatment that would benefit the patient permanently. A two-stage operation was performed, the first stage being performed August 24, 1928. The hyoid bone was divided; the larynx and trachea were skeletonized; the isthmus of the thyroid gland was divided, and the skin was sutured to the region of the second ring of the trachea. August 27, the trachea was opened just below the cricoid cartilage. August 31, laryngectomy was performed. The growth was found to be extensive; it involved the entire left

side of the larynx, extended behind the cricoid, and involved 2.5 cm. of the upper end of the esophagus on the posterior surface of the larynx. It was possible to cut entirely around the growth in normal mucous membrane (Fig. 35). The usual closure was made; the wound in the neck was completely closed except that one small rubber drain was left below the tracheal opening.

The patient progressed satisfactorily following the operation, and there was little postoperative reaction. Although there was

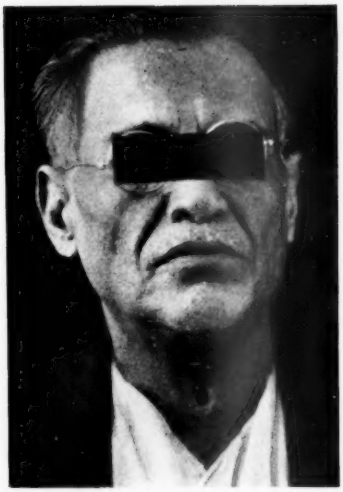


FIG. 35.—(Case V.) Appearance of patient following laryngectomy for extensive extrinsic epithelioma.

a large pharyngeal opening following removal of the tumor, a pharyngeal fistula was not present (Fig. 36).

Surgical procedures give the only chance for a permanent cure in carcinoma of the larynx, and therefore one is warranted in operating on extensive tumors such as the one in this case. The operative mortality in laryngectomy is low, and during the last three years, 1925 to 1928, forty-three patients have been subjected to the operation at the Clinic without a death. There were three deaths following the first stage; one was the result

of a mistake in anesthesia, and the other two were caused by bronchopneumonia in patients who constituted poor surgical risks. With the type of two-stage operation that is being used now, most of the patients do not have to wear a tracheotomy tube; this facilitates the use of an artificial voice box. The

FIG. 36.—(Case V.) Epithelioma of the larynx; the growth extended from the epiglottis well into the upper end of the esophagus.

artificial voice box greatly improves the morale of these patients. Although buccal speech is developed very satisfactorily by some patients, those who are unable to learn this are rehabilitated by means of the artificial voice box.

BIBLIOGRAPHY

1. Chappell, W. F.: Large tumor of the laryngo-pharynx removed by subhyoid pharyngotomy, Tr. Am. Laryngol. Assn., 1907, 98–104.

2. New, G. B.: Cystic odontomas. Jour. Am. Med. Assn., 1915, lxiv, 34–39.

3. New, G. B.: Fibrolipoma of the larynx. Jour. Am. Med. Assn., 1916, lxvi, 566–567.

4. New, G. B.: A two-stage laryngectomy. Surg., Gynec. and Obst., 1928, xlvii, 826–830.

DERMOID CYST OF THE FLOOR OF THE MOUTH: REPORT OF A CASE

FREDERICK A. FIGI AND STUART W. HARRINGTON

TRUE dermoid cysts of the floor of the mouth are rare, although such tumors frequently are encountered in the body. The most common sites of their development are in the outer portion of the brow, just above the tip or on the bridge of the nose, on the neck, about the sternum, in the mediastinum, sacrum, scrotum, ovary, or perineum. They may also occur in the mastoid region, palate, pharynx, or at the base of the brain. Most of them are congenital, although many do not become evident until the age of puberty or during early adult life. Cavaud, Flinn, and Ollerenshaw reported cases in which dermoid cysts of the floor of the mouth were present at birth. The case to be presented here may be added to this group.

Dermoid cysts develop as a result of the inclusion of epidermis within the deeper tissues. As pointed out by Mikulicz, this may result from fusion of body walls in the median line, from closure of clefts or channels which during fetal life were covered with epithelium, or from abnormal deposits of epidermis in the deeper tissues. The last may be due to trauma or fetal accident. Most dermoid cysts of the floor of the mouth probably result from imperfect fusion of the first and second branchial arches since these enter into the development of the mandible and the hyoid bone, respectively.

Dermoid cysts occurring in the floor of the mouth are usually in the median line, although they may be situated laterally. They lie above the mylohyoid muscle, but may cause the submental area to bulge markedly. In some cases they do not have a bony attachment. More often, however, they are attached to either the mandible or the hyoid.

The gross appearance and contents of dermoid and sebaceous cysts are strikingly similar, and many pathologists consider the two conditions identical. Colp, in his thorough review of this subject, clearly pointed out the difference between the two conditions. Their mode of development and histologic features are entirely different; a sebaceous cyst is due to the continued accumulation of sebum within a sebaceous gland, presumably from obstruction of the orifice of the follicle, while dermoids develop from epidermis present in the deep tissues, resulting either from sequestration of ectoderm during fetal life or from trauma. Colp stated further that cysts to be classified as dermoids must have the histologic evidences of skin, but that just as there are certain areas of skin without hair follicles, with few sweat or sudoriferous glands, so it is common to find dermoids lacking in some of the appendages of true skin. Besides, by the process of desquamation, the epithelium may be reduced to a few layers. Although hair follicles may not be present, sebaceous and sweat glands are usually evident in great numbers.

Patients with dermoid tumors of the floor of the mouth often do not recognize the presence of the growth until it has attained sufficient size to interfere mechanically with movements of the tongue. The appearance of an enlargement in the submental region is at times the first evidence of the tumor noticed by the patient. Instances have been reported in which the patient himself was unaware of this until his attention was directed to it by an observing friend. The most prominent symptoms aside from the presence of the tumor are the difficulty in articulation, the speech becoming thick and "mush-mouth" in type, and difficulty in mastication and swallowing. There is not, as a rule, associated pain or tenderness unless the mass becomes acutely inflamed. It may then rupture through the floor of the mouth or into the submental or submaxillary area. Following this, a discharging sinus often develops, while the cystic enlargement disappears. The sinus may heal and the cyst may refill; rarely the cyst and sinus may be entirely obliterated. Dyspnea is at times associated with the presence of very large

tumors, especially if rapid inflammatory enlargement has taken place.

On general examination the appearance of a dermoid cyst of the floor of the mouth is so characteristic that an accurate clinical diagnosis can be made in a high percentage of cases. The tumor which often causes bulging of both the anterior part of the floor of the mouth and the submental area is rounded or oblong, usually is quite soft, and has a characteristic doughy or putty-like consistence. In some cases pitting occurs on pressure. Palpation gives the impression of a thick-walled cyst in contradistinction to the thin-walled ranulas occurring in this region. The mucous membrane covering the upper surface of the tumor is usually normal in appearance. In the case reported here, however, it was under tension and was yellowish-gray. The size may vary from about 1 cm. to a mass several centimeters in diameter which completely conceals the tongue and pharynx. Dermoid cysts in this region have been recorded up to 15 cm. in diameter. Except for large tumors, the growth is usually freely movable.

In the differential diagnosis of dermoid cysts in the floor of the mouth, there are few conditions requiring serious consideration aside from other types of congenital cysts, and these often can be differentiated only by microscopic study following their removal. Ranulas and mucous cysts, as a rule, present an entirely different appearance, having a thin, glistening wall and often being slightly bluish. Lipomas at times occur in this region and may offer some difficulty in diagnosis, although in general their consistence is strikingly different. The angiomas, like the ranulas, present a bluish color and are distinctly compressible.

The treatment of dermoid cysts in this region is excision, either through the floor of the mouth or through the submental area. Aspiration followed by the injection of a caustic fluid, which formerly was practiced, carries with it too much danger and is too uncertain in its results to be advisable.

REPORT OF A CASE

A baby boy aged fifteen months was brought to the Clinic October 19, 1928, on account of a tumor under the tongue and a discharging sinus beneath the chin. The mother stated that difficulty in sucking and in swallowing had been noted since shortly following birth and that examination in early infancy had revealed a mass in the floor of the mouth anteriorly, crowding the tongue against the palate. Six months previous to admission, the tumor and surrounding tissues became acutely inflamed and there was some associated respiratory embarrassment. The mass ruptured spontaneously into the submental region, and thick, creamy material had discharged continuously since.

Examination at the Clinic showed a moderately soft, rounded, boggy, cystic mass about 2 by 2 by 2.5 cm. which caused the anterior floor of the mouth to bulge; its upper surface was about on a level with the occlusal surfaces of the lower teeth. The tumor appeared to be covered only by the tense, buccal mucous membrane through which its yellowish-gray color shone. A discharging sinus was present in the submental region and a tract led from this to the tumor in the floor of the mouth. Thick, creamy material was readily expressed. Neither the tumor nor the sinus appeared to be tender. The child's physical examination otherwise was entirely negative. Dermoid cyst was diagnosed. Excision was carried out under ether anesthesa October 23.

A draining sinus was present in the submental region about 1 cm. posterior to the mandible. An incision was made parallel to the mandible, permitting excision of an elliptical area of skin around the sinus tract. The dissection was carried through the platysma, and continued to the left with exposure of the anterior belly of the digastric muscle. The sinus tract was found to extend between the anterior bellies of the digastric muscles in the median line, and then between the hyoglossus and mylohyoid muscles, whence it opened into a large sac which completely filled the floor of the mouth, pushing the sublingual glands and mucous membrane of the floor of the mouth forward

and upward. The neck of the sac was easily separated from the surrounding muscles but the sac itself was firmly adherent to

FIG. 37.—Wall of dermoid cyst containing lining of epidermis, hair follicle, and numerous sebaceous glands. (×75.)

FIG. 38.—Higher magnification of same field as shown in Fig. 37. (×150).

all of the surrounding structures, particularly to the mucous membrane of the floor of the mouth which was carefully dissected

off without rupture of the mucous membrane or the cyst. The mylohyoid and hyoglossus were approximated with interrupted sutures, and a small gauze drain was inserted into the cavity produced in the floor of the mouth. The platysma was sutured and the wound closed with interrupted sutures. The small wick of gauze was removed after forty-eight hours (Figs. 37 and 38).

Convalescence was uneventful. The patient was dismissed from hospital on the seventh day and from observation on the twelfth day. The wound was entirely healed, and the general condition was good.

COMMENT

Surgical intervention is indicated in all such cases, the type of operation and approach depending on the condition present in the individual case. In many cases the tumor presents entirely in the floor of the mouth, under the tongue, and is best exposed through the mouth. In this case the infection which had taken place at some previous time had resulted in a draining sinus in the submental region and the tumor was best removed by the submental approach. The operative results in such cases are satisfactory and recurrence of the lesion is rare.

BIBLIOGRAPHY

1. Cavaud: Quoted by Colp.

2. Colp, Ralph: Dermoid cysts of the floor of the mouth. Surg., Gynec. and Obst., 1925, xl, 183–195.

3. Flinn, D. E.: A rare case of the congenital form of ranula. Tr. Roy. Acad. Med. Ireland, 1890, viii, 222–224.

4. Mikulicz: Quoted by Colp.

5. Ollerenshaw, Robert: On dermoids of the tongue, with a report of a large sublingual dermoid cyst. Brit. Med. Jour., 1912, i, 1290–1291.

CASES FROM THE CLINIC OF FRED W. RANKIN

FRED W. RANKIN AND CHARLES L. CHUMLEY

HEMANGIOMA OF THE SUBMENTAL REGION

Case I.—A man aged thirty-eight years came to The Mayo Clinic March 28, 1928, complaining of a tumor under the chin which had been present for about three years but had remained small until one year previously, at which time it began to enlarge

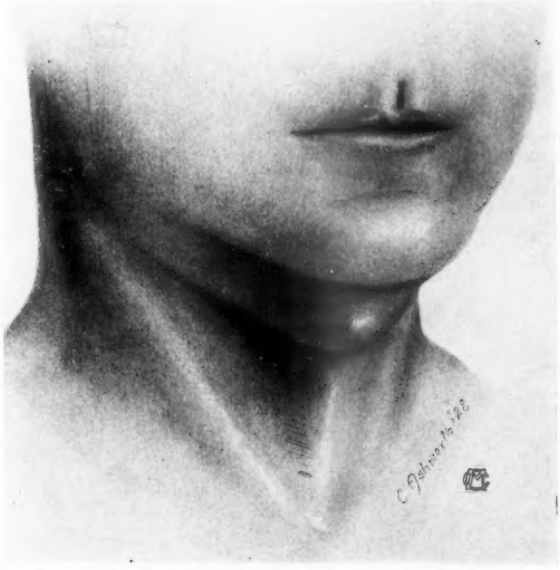


FIG. 39.—(Case I.) Appearance of the tumor before operation.

slowly and continued to do so until the time of admission. He thought the tumor became harder and larger at times, especially after he had talked a great deal. Aside from the tumor the

patient complained of constipation and stated that four years previously he had had an attack of epigastric distress. A diagnosis of ulcer had been made by the attending physician and he was placed on a diet. Since that time he had been free from gastric symptoms.

On examination the tumor was found in the median line of the neck in the submental region (Fig. 39). It was about 3

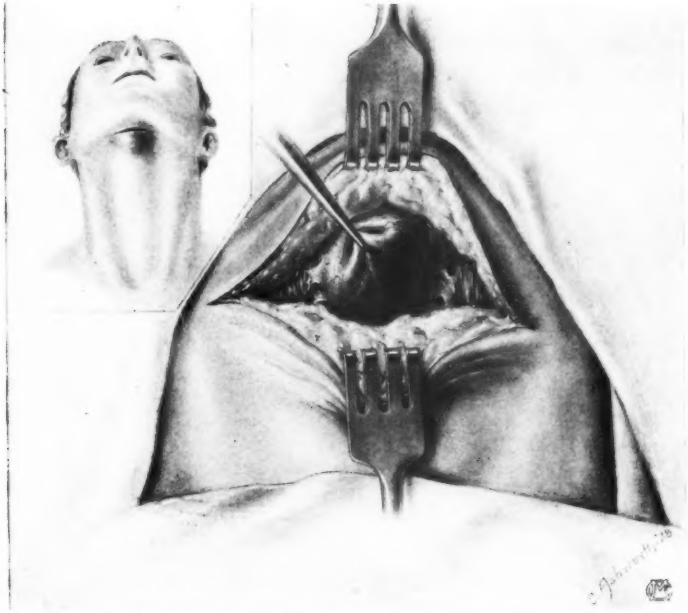


FIG. 40.—(Case I.) Incision and appearance of tumor after exposure.

by 4 cm. and of a soft or semisolid consistence. It did not seem to be attached to surrounding structures and it was not tender on palpation. The general examination was otherwise negative. The hemoglobin was 78 per cent; the erythrocytes numbered 4,790,000 and the leukocytes 7,200. The Wassermann reaction on the blood was negative. Urinalysis did not reveal anything abnormal. Gastric analysis showed total acidity 70

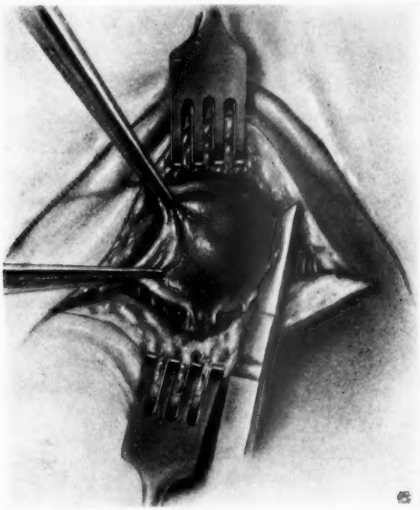


FIG. 41.—(Case I.) Method of removal of hemangioma.

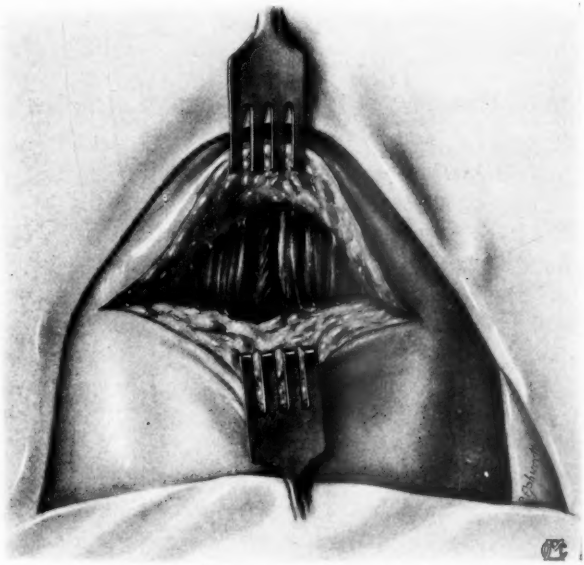


FIG. 42.—(Case I.) Field of operation after removal of tumor.

and free hydrochloric acid 58 one hour after the test meal. Roentgen-ray examination of the stomach and duodenum showed a duodenal ulcer.

The tumor was excised under local anesthesia. It was completely encapsulated (Figs. 40 to 43). The pathologist diagnosed fibrous hemangioma. The patient's convalescence was uneventful.

Hemangiomas which are completely encapsulated, as was the tumor in this case, are apparently not common. McFarland

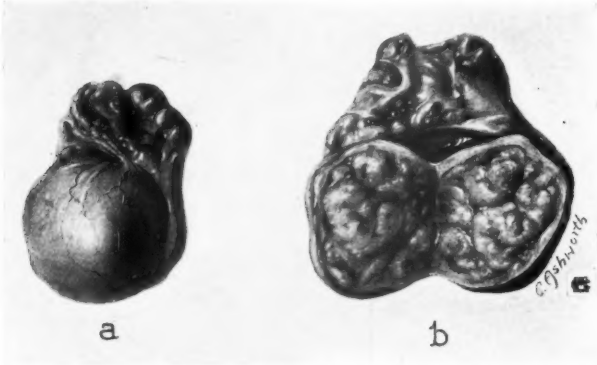


FIG. 43.—(Case I.) *a*, Tumor after removal, showing complete encapsulation; *b*, appearance of tumor on section.

stated that only in rare instances are angiomas encapsulated. In a somewhat larger number they are well circumscribed, but in most cases they have ramifications that extend widely into neighboring tissues. In regressing cavernous hemangiomas, according to Ewing, a fibrous capsule may form or fibrous areas appear in the tumor, the sinus walls thicken and contract, and eventually only scar tissue remains. Hemangiomas are usually divided into three types:

1. **Angioma simplex or capillary angioma.**—This tumor is formed of capillary blood vessels embedded in more or less abundant connective-tissue stroma. The channels are frequently dilated or pouched and usually form an intricate mass

of curled and intertwined vessels. These growths are most common in the skin or subcutaneous tissue especially of the face and neck where they are known as birthmarks. They may be level with the skin or raised above it. They may be circumscribed or diffuse.

2. **Angioma cavernosum.**—This tumor consists largely of intercommunicating blood spaces, irregular in shape and size, lined with endothelium and surrounded by connective tissue. The structure resembles the erectile tissue of the corpora cavernosa and these tumors may pulsate. This type of angioma is found in the skin or subcutaneous tissue, or in any of the organs of the body, but most frequently in the liver. Most authors include these types of angiomas among the malformations and not among true tumors, as they believe these growths do not possess any power of independent proliferation. Others assert that they may grow and metastasize.

3. **Angioma simplex hypertrophicum.**—This lesion is acknowledged as a genuine neoplasm. The capillaries show evidence of proliferation and since it is the endothelium that grows so vigorously they have been called hemangio-endothelioma.

SALIVARY CALCULI IN THE RIGHT SUBMAXILLARY GLAND

Case II.—A man aged fifty-one years first came to the Clinic in July, 1926, but did not remain until the examinations were completed. The chief complaints at that time were epigastric pain, diarrhea, nervousness, and swelling in the right submaxillary region. Twenty-seven years previously he had noticed swelling in the right submaxillary region which was incised by his physician and which drained pus for more than a year. It then healed, leaving a wide scar.

On examination the patient was found to have an adenomatous goiter with hyperthyroidism. The basal metabolic rate was +31. The right submaxillary gland was enlarged and firm. Urinalysis showed albumin. The blood count was normal and the Wassermann reaction on the blood was negative. There was marked dental and tonsillar sepsis. Roentgen-ray examination of the chest showed bilateral bronchiectasis; it was

negative of the gallbladder. The patient did not receive further examination or advice.

The patient's next visit to the Clinic was in May, 1927, at which time his complaints were the same as before. A diagnosis of adenomatous goiter with hyperthyroidism, salivary calculi, and dental and tonsillar sepsis was made. The patient was operated on May 23, when subtotal thyroidectomy with double resection and removal of the isthmus was performed. The pathologist reported adenomatous goiter. The gland removed

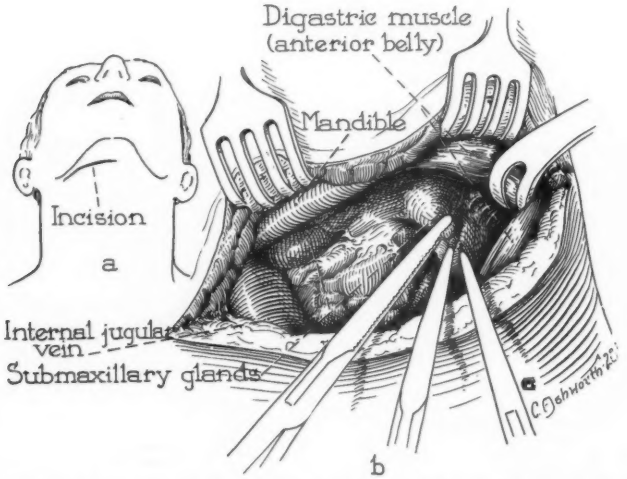


FIG. 44.—(Case II.) *a*, Incision; *b*, dissection of right submaxillary salivary gland.

weighed 170 gm. The patient's convalescence was uneventful and he was dismissed from observation but advised to return for removal of the salivary calculi.

The patient returned in March, 1928 complaining of profuse flow of saliva and a drawing sensation in the neck. The right submaxillary gland was large and firm, roentgen-ray examination of which showed multiple calculi in the substance of the gland. His general condition was good.

Under local anesthesia the right submental and submaxillary

group of glands was excised (Figs. 44 and 45). The pathologist reported chronic inflammation of the submaxillary gland with three stones, the largest 13 mm. and the smallest 4 mm. in diameter. Convalescence was uneventful.

Salivary calculi are relatively uncommon. Harrison searched the literature from 1825 to 1926 and found only 375 reported cases. To this number he added twenty-seven of his own. Calculi may occur at any age. In one case reported in the literature, stones were found in the salivary gland of an infant aged

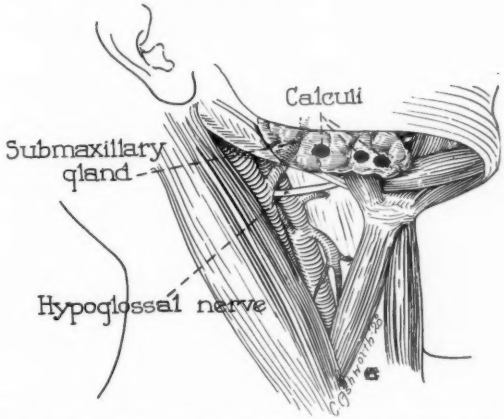


FIG. 45.—(Case II.) Situation of stones in substance of gland.

less than one month. They are more common in males than in females. They are usually single but may be multiple, as many as fourteen stones having been removed from a single gland and its duct. They vary from 0.5 mm. to a weight of more than 60 gm. In about 75 per cent of all reported cases of salivary calculi the stones were in the submaxillary ducts or glands; about 20 per cent were in the parotid and a very small number in the sublingual ducts or glands.

A stone may be present in a duct or gland without producing symptoms provided there is no infection or obstruction to the outflow of saliva, and when symptoms are produced they vary according to the amount of infection and obstruction present.

Harrison stated that the earliest and most classical symptom present in the majority of cases is, according to French authorities, salivary colic, which is produced by retention of saliva and is accompanied by varying amounts of pain and discomfort in the region of the affected duct or gland, occurring immediately on eating or at the sight of food.

The diagnosis of salivary calculi is usually easily made from the history supplemented by bimanual palpation and roentgen-ray examination, the latter being positive in from 75 to 80 per cent of the cases. Probing of a duct as a diagnostic procedure seems to be rarely, if ever, indicated, as the duct may be perforated in this manner. Blair uses a hypodermic needle attached to a syringe filled with a local anesthetic solution and infiltrates the tissues about the duct as he passes the needle through them in an effort to locate the stone.

When salivary calculi are found in a duct or a gland, operation is indicated. According to Harrison, the stone should be removed by an intra-oral incision if situated in the sublingual duct or gland, the anterior two-thirds of the submaxillary duct or the buccal portion of the parotid duct, and by an external incision if they are situated in the masseteric portion of the parotid duct, parotid gland, the posterior third of the submaxillary duct, or the submaxillary gland. Total extirpation of the sublingual or submaxillary gland is indicated if a stone is present in the substance of the gland or if there is marked inflammation of the gland although the stone is in the duct.

TUMOR IN THE RIGHT SUBMAXILLARY REGION (NONCASEOUS TUBERCULOSIS)

Case III.—A woman aged sixty-five years first visited the Clinic September 16, 1925 because of a nodule in the left breast. A diagnosis of essential hypertension and carcinoma was made and radical amputation of the left breast performed. The pathologist reported adenocarcinoma with involvement of one lymph node. Convalescence was uneventful. The patient was given roentgen-ray treatment and was permitted to go home. She returned to the Clinic June 15, 1926 on request, and her

examination, including roentgen-ray examination of the chest, was negative for recurrence, and the hypertension was under control.

The patient again registered at the Clinic June 6, 1928, complaining of slight swelling in the right submaxillary area which had been present five weeks. The tumor appeared while she was suffering from a cold. The growth was not accompanied by pain or other symptoms. Her general health was good.

Examination revealed a firm movable tumor, about 2 by 4 cm., in the right submaxillary region. The systolic blood pressure was 170 and the diastolic 100. The general examination was otherwise negative. The urine was normal. The hemoglobin was 73 per cent; the erythrocytes numbered 4,710,000 and the leukocytes 6,500. Roentgen-ray examination of the chest was negative. There was no evidence of recurrence of the carcinoma of the breast.

The tumor was thought to be inflammatory, and under local anesthesia it was excised. It was about 3.5 cm. in diameter and completely encapsulated. The pathologist reported noncaseous tuberculosis. Convalescence was uneventful.

So much has been written about tuberculosis of the cervical lymph nodes that we hesitate to comment on the subject. The case just reported, however, is interesting for a number of reasons: the duration of the disease was short; the tumor was movable and had not undergone caseation; the onset was apparently during the time that the patient was suffering from an acute upper respiratory infection; there was no evidence of tuberculosis elsewhere in the body and the patient was known to have had a radical operation for carcinoma of the left breast three years previously. Local development of tuberculous glands suggests lymphatic infection and more especially if the affected nodes lie in the lymphatic connection with such obvious areas of absorption as the tonsil which may serve as a portal of entry for the bacilli of tuberculosis. In about 20 per cent of the cases of tuberculous adenitis the first nodes involved are in the submental and submaxillary regions. Infection by way of the blood stream is believed to occur in only a small percentage of cases.

This case is also interesting from the standpoint of diagnosis. The usual case of tuberculosis of the cervical lymph node with a history of chronicity is easily recognized. We suspected that the tumor in this case was inflammatory in origin even though the patient had suffered from carcinoma elsewhere in the body. It was not possible, however, to be sure of its pathologic nature until it was removed and studied microscopically.

One may wonder about the prognosis in this type of case. It seems that the early removal of a solitary noncaseating tuberculous nodule, together with eradication of all nearby foci of infection, should offer the best possible chance of permanent cure. As a rule, tuberculosis of the cervical lymph nodes is not seen by the surgeon before caseation and the formation of conglomerate masses.

ADENOCARCINOMA (MIXED TUMOR) OF THE LEFT SUBMAXILLARY GLAND

Case IV.—A man aged thirty-eight years was admitted to the Clinic February 6, 1928, complaining of a tumor of the left side of the neck of twenty-three years' duration. He first noticed a small lump in the left upper cervical region when he was about fifteen years old. Its size had remained about the same for a number of years. It was not painful and did not cause discomfort. His general health was good.

The tumor was found to be in the left submaxillary triangle and was hard, nodular, and freely movable. There was no tenderness on palpation. The hemoglobin was 74 per cent; the erythrocytes numbered 4,630,000 and the leukocytes 7,600. The Wassermann reaction on the blood was negative. The urine appeared to be normal. A diagnosis of mixed tumor was made and operation advised.

Under local anesthesia the tumor, about 3.5 cm. in diameter, together with the left submaxillary gland, was removed. A gauze pack saturated with Harrington's solution was inserted and the wound closed. The pathologist reported adenocarcinoma (mixed type).

The patient's convalescence was uneventful and he was dis-

missed from the hospital on the fifth day. He then received radiotherapy and was allowed to go home at the end of three weeks from the date of operation. He returned to the Clinic four months later and there was no evidence of recurrence at that time.

This type of tumor is usually found in association with the salivary glands and for this reason so-called mixed tumors of the salivary gland are a very interesting group, not only because of their obscure etiology but because of their clinical and pathologic characteristics. Such tumors are relatively uncommon and constitute a small percentage of the malignant tumors of the body. Sistrunk found that they occurred in only 0.062 per cent, or in one of every 1,607 patients who were examined in The Mayo Clinic over a period of four years.

Although mixed tumors may be found in the lips, oral cavity, pharynx, and larynx, they are usually found in the parotid and submaxillary regions. The cases observed at The Mayo Clinic previous to 1911 have been reported by Judd, those from 1912 to 1915 by New, and those from 1915 to 1919 by Sistrunk. In each group the tumors were found from ten to twelve times as often in the parotid gland as in the submaxillary salivary glands. The sixty-eight cases studied by New were situated as follows: Larynx, one; pharynx, four; palate, three; upper lip, three; sublingual region, one; cheek, one; submaxillary region, five, and parotid, fifty.

The origin of mixed tumors is not known. Some pathologists classify them as endotheliomas arising from the blood vessels, others as carcinomas originating in the substance of the gland, and still others believe them of embryonic origin. New believes they should not be classified as mixed tumors of the salivary glands until there is some evidence to show that they are related to these glands.

The most common clinical characteristic of mixed tumors is that a small, painless, rounded or nodular tumor is usually discovered accidentally by the patient, and if left undisturbed, may grow slowly and then remain stationary for many years, after which it may begin to grow again, sometimes rapidly. Some

grow slowly but continuously without any period of rest. In one case reported by New, the tumor had been present forty years, in five cases for more than thirty years, and in twenty-two cases for more than ten years. In almost half of the cases in his series the tumor had been present for more than five years. These tumors ordinarily vary in size from 1 to 8 cm., but may become much larger. After they have persisted for a long time they may become cystic.

The diagnosis in the early stage is not easy except that any hard, nodular, movable tumor in proximity to a salivary gland may be suspected of being a mixed tumor. If the growth has been present for months or years it is rather evident that it is a mixed tumor. In certain cases, however, it may be impossible to make a diagnosis until the tumor is removed and subjected to microscopic study.

The treatment of mixed tumors is surgical. The removal of these growths when they are small and completely encapsulated should result in cure. It is a well known fact, however, that mixed tumors are prone to recur, particularly in the parotid region. Tumors of the submaxillary gland in which the growth with its capsule and the submaxillary gland may be removed en masse, as in the case reported here, should rarely, if ever, be followed by recurrence.

POLYP OF THE SIGMOID

Case V.—A man aged fifty-one years came to the Clinic complaining of constipation, rectal bleeding, dysuria, and nocturia. He stated he had been constipated for many years but had not resorted to the use of cathartics frequently, although his stool was, as a rule, very hard. He had noted streaks of blood on the stool occasionally for several years and for the last two years he had observed the presence of blood more frequently. At first it appeared in small amounts and was red, but more recently it appeared in larger amounts and was darker and partially mixed with the stool. Occasionally with straining at stool there would be a protrusion from the rectum which would have to be replaced. The patient also complained of an indefi-

nite, diffuse, cramping pain in the lower part of the abdomen at times during defecation and of itching about the anus which was worse at night. He also stated that eight years previously he had had an attack of pain in the right renal area which was diagnosed as renal colic. Since that time he had had similar attacks of sharp severe pain beginning in the right lumbar region and radiating to the right testicle. He complained of nocturia recently and also of difficulty in voiding.

Examination showed that the patient was well developed and well nourished, and of normal weight. The systolic blood pressure was 120 and the diastolic 80. The hemoglobin was 68 per cent; the erythrocytes numbered 3,870,000 and the leukocytes 8,400. The Wassermann reaction on the blood was negative. Gastric analysis showed total acidity 70 and free hydrochloric acid 46, in 80 c.c. of material obtained from the stomach one hour after the test-meal. Roentgenograms of the chest, stomach, kidneys, ureters, and bladder were negative. Roentgenologic examination of the colon showed a filling defect in the sigmoid. Investigation of the urinary tract showed normal urine, residual urine of 30 c.c., and the combined phenolsulphonephthalein output of 55 per cent at the end of one hour. Cystoscopic examination did not reveal anything abnormal except prostatic-bar hypertrophy, graded 1. Proctoscopic examination revealed hemorrhoids. A diagnosis of sigmoid polyp, hemorrhoids, pruritus ani, prostatic-bar hypertrophy, and moderate secondary anemia was made. The patient was advised to have an exploratory operation with removal of the polyp.

Spinal anesthesia was administered and the abdomen opened through a low median-line incision. Exploration of the abdomen revealed the polyp which was situated in the middle portion of the sigmoid and opposite the mesenteric attachment (Fig. 46). The sigmoid was incised with cautery longitudinally through one of the longitudinal bands. The polyp was removed with cautery and the mucous membrane approximated over the site of attachment with catgut sutures. The incision in the sigmoid was closed with two rows of continuous catgut and a third row of interrupted silk sutures (Fig. 47). The abdomen was closed

without drainage. The pathologist reported pedunculated adenoma, 2 by 5 cm.

The patient's convalescence was uneventful and he was dismissed from observation on the twenty-first day after operation.

Although most benign tumors of the colon are polypoid and of the adenomatous variety, other histologic types occasionally

FIG. 46.—(Case V.) Isolation of tumor which is held between thumb and index-finger; the dotted line shows actual size.

met with are fibromas, lipomas, myomas, and hemangiomas. Of the cases of polyps of the colon at The Mayo Clinic studied by Saint, thirty-six were adenomatous. Ewing divided such adenomas into three types: (1) The broad, flat adenoma; (2) the common pedunculated adenoma, and (3) the villose papil-

loma. Almost all benign tumors of the colon, even if sessile at the beginning, probably sooner or later tend to become pedunculated owing to the constant downward pressure of the intestinal contents. Of the entire gastro-intestinal tract, polyps are most often found in the rectum where they may be solitary but are frequently multiple. Of the large intestine the lower part of the sigmoid is a favorite site for single polyps and localized papillomatous growths. Twenty of the cases of polyps of the colon tabulated by Saint were in the sigmoid.

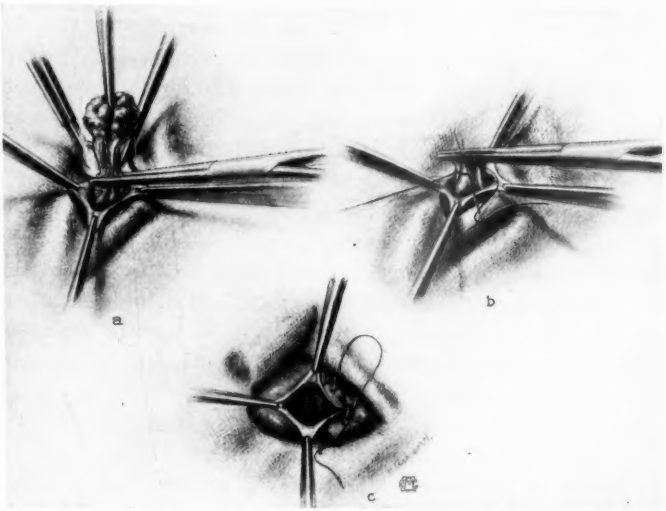


FIG. 47.—(Case V.) *a*, Exposure of polyp with pedicle clamped; *b*, transfixion and ligation of pedicle; *c*, closure of wound in bowel.

Transperitoneal sigmoidotomy for removal of single isolated benign tumor has been employed a number of times at the Clinic, first by W. J. Mayo in 1917. It is a procedure not without hazard and yet in our experience simple and satisfactory. The sigmoid and, indeed, the whole left side of the colon and occasionally the ampullary portion of the rectum are often the site of solitary tumors of the adenomatous or papillomatous variety which may be satisfactorily removed by this method.

Although isolated polypoid growths or single benign tumors of any nature are in the minority as compared to malignant tumors of this portion of the gastro-intestinal tract, single-stage operations for their extirpation are indicated in the absence of obstruction. The tendency of small adenomas to undergo malignant change can be definitely demonstrated pathologically, and when a large adenoma or benign polyp of other pathologic type is found isolated in a segment of the intestine, its removal as a precaution against malignant development is indicated. Again, intussusception often results from the traction of large pedunculated tumors which are usually situated opposite the mesentery and grasped by the peristaltic waves of the bowel, invaginating the upper loop of the colon into its distal segment. Occasionally retrograde intussusception has been noted in cases in which a similar etiologic factor is involved.

With coöperative management of surgical colonic cases, opening of the bowel without preliminary procedure may be accomplished with relative safety when the obstructive conditions have been overcome. Adequate measures to cleanse the colon have reduced the obstruction and infection, and rehabilitation measures have permitted many one-stage operations accompanied by a safety-valve adjunct not only for benign but occasionally for malignant processes.

When the tumor has been exposed by this method and there is any suspicion on the part of the operator as to the nature of the growth, a portion may be removed for study of a frozen section. If this proves to be malignant the tumor can be dealt with accordingly. W. J. Mayo has called attention to the fact, however, that a positive opinion here is the only one of value unless the entire growth is given to the pathologist, and also to the inadvisability of removing portions of a doubtful tumor. He believes that the area from which the fragment is taken should be thoroughly cauterized in event the tumor is not removed immediately, in order to prevent infection and dissemination of malignant cells.

Although we have discussed the transperitoneal approach for removal of benign solitary tumors of the sigmoid portion of the

colon alone, there is no reason why it is not applicable to similar types of growths situated in other segments of the large intestine. We know, however, that polyps in sections other than the sigmoid are most likely to be multiple and yet are difficult to detect so that some may be left behind and later undergo malignant change or bring about intussusception. It is also well known that multiple polyps are often associated with chronic ulcerative inflammation of the colon and are in these cases so numerous that their removal is an absolute impossibility without radical resection of the entire polyp-bearing segment of the colon.

The technic of transperitoneal sigmoidotomy which has been described by W. J. Mayo is as follows: The abdomen is opened in the median line suprapubically and a Balfour self-retaining retractor adjusted. The patient is placed in a moderate Trendelenburg position. The small intestine is packed off with gauze and the sigmoid lifted up and opened through the anterior white band at a point opposite the tumor. The growth is exposed and delivered through the incision until sufficient normal mucous membrane is everted to apply a clamp well beneath the base of the tumor. The tumor is cut off with cautery and the wound in the mucous membrane closed by a continuous suture of chromic catgut. The incision in the sigmoid is then closed with continuous catgut and interrupted silk.

A BRIEF REVIEW OF THE USE OF ANESTHETICS IN THE MAYO CLINIC IN 1927

JOHN S. LUNDY

MY impressions of the use of anesthetics in The Mayo Clinic during 1925 and 1926 appear elsewhere.[2, 3] Several changes were made in the methods of producing anesthesia and

TABLE 1

ALL AGENTS USED: PERCENTAGE OF CASES IN WHICH SINGLE ANESTHETIC AGENTS, OR CERTAIN WELL RECOGNIZED COMBINATIONS OF AGENTS, WERE USED TO THE EXCLUSION OF OTHER AGENTS.*

Agent.	1927. Per cent.	1926. Per cent.	1925. Per cent.	1924. Per cent.	1923. Per cent.	1922. Per cent.
Local	40.20	42.7	45.00	43.20	42.20	42.2
Local and ether	0.30	0.8	1.70	1.40	1.10	8.6
Local and gases†	11.60	11.4	4.10	0.90		
Ether	19.60	19.1	20.30	25.80	40.80	44.9
Gases†	26.90	25.3	28.40	27.60	15.40	3.8
Chloroform	0.03	0.1	0.09	0.08	0.10	
Ethyl chlorid†	0.30	0.1	0.10	0.20		
Oil-ether colonic	0.60	0.1	0.01			
Spinal‡	0.40			0.01	0.04	0.4
Total	100.00	100.0	100.00	100.00	100.00	100.0

* Includes the local anesthetic used for extraction of teeth, thyroidectomy, tonsillectomy, hemorrhoidectomy, and so forth. Each figure in the tables is computed from the number of individual cases for the year compared with the total number of cases for the year.

† With or without ether.

‡ With or without general anesthesia.

in the use of anesthetics in 1927. Tables 1 and 2 indicate, in general, this trend from year to year over a period of six years. The data presented differ from those appearing in previous articles in that certain explanatory figures (Table 2) have been

TABLE 2

AGENTS OF SPECIAL INTEREST: PERCENTAGE OF CASES IN WHICH CERTAIN ANESTHETIC AGENTS WERE USED, BOTH ALONE AND IN COMBINATION WITH OTHER AGENTS.

Agent.	1927. Per cent.	1926. Per cent.	1925. Per cent.	1924. Per cent.	1923. Per cent.	1922. Per cent.
Local	52.2	55.0	50.8	46.1	43.3	51.2
Ether	45.9	43.4	39.9	44.7	41.9	53.5
Ethylene	33.5	31.6	29.6	24.1	15.4	
Nitrous oxid	18.9	12.5	11.7	5.1		3.8
Carbon dioxid*	25.0	12.6	11.3	0.3		

* Used as a respiratory stimulant only; not as an anesthetic.

added. In reading the figures in Table 1 for 1927 it may be noted that the use of local anesthesia was itemized to show that it was used alone in 40.2 per cent of cases; with ether in 0.3 per cent; in combination with a gas, with or without ether, in 11.6 per cent, and in the form of spinal anesthesia in 0.4 per cent. On the other hand, the use of local anesthesia has been summarized in Table 2 to show that it was used in 52.2 per cent of the cases, regardless of whether it was used alone or in combination with a general anesthetic. This summarizing figure, 52.2 per cent, has been determined from the total number of cases, in order to eliminate the error which would occur if one were to add together the percentages presented in Table 1. In a somewhat similar manner the use of ether, ethylene, carbon dioxid, and nitrous oxid is tabulated.

LOCAL ANESTHESIA

In discussing the data for 1926 I said that local and regional methods of anesthesia were being applied about as liberally in 1926 as I would expect to see them applied in 1927.[3] The figures have borne out this prediction. There is, however, a striking exception, for spinal anesthesia was reintroduced in July, 1927 for a selected group of cases. Spinal anesthesia was used in 0.4 per cent of the cases in 1927 and in 1922, although in 1927 it was used for only six months as compared with the twelve months of 1922. Spinal anesthesia was used principally when the operation was for malignant lesion of the large bowel. It was also used in a few cases of intestinal obstruction. The success attending its recent use will be reported elsewhere.[5] There can be little doubt but that the use of ephedrin as a supportive and prophylactic measure to prevent the untoward reaction which often occurs during spinal anesthesia has been largely responsible for the successful reintroduction of spinal anesthesia. If certain investigations[1] bring to light other drugs, such as ephedrin, or measures which will add further to the safety of spinal anesthesia, its use will probably be greatly extended. The principal drawback to spinal anesthesia still is the occasional severe untoward reaction which accompanies its use. Spinal anesthesia will have been used in a larger number of cases in 1928 than in 1927. However, I believe that its extended use will depend on the employment of a technic which will safely permit the production of more enduring anesthesia. If anoxemia is avoided, death under spinal anesthesia may be prevented. This opinion has been borne out in the experimental laboratory with the aid of a pulmonary ventilator.[1]

COMBINED ANESTHESIA

A combination of general and local anesthesia was used in about the same number of cases in 1927 as in 1926; the data for 1928 will show little change. This form of anesthesia is a particularly valuable one for the patient who is a poor risk and is nervous, and it is the best balanced anesthesia for routine use according to present-day methods. It was used extensively for

operations on the thyroid gland and on the duodenum and stomach. The frequency with which ether was used when a gas was combined with local anesthesia will be noted in the remarks on ethylene and nitrous oxid.

ETHER

The popularity of ether given by the semi-open drop method varies but little each year, and I expect but little increase in the percentage of cases in which it will have been used in 1928. In Table 2 it will be seen that ether has been used in some way in almost as great a proportion of the cases in 1927 as in previous years. The real usefulness of ether has not decreased, but there has been a change in the method of administration. In 1922 and 1923 it was used mostly by the semi-open drop method, whereas now it is used to reinforce either ethylene or nitrous oxid; it is not advisable to induce anoxemia in addition to anesthesia and thereby attempt to avoid the use of ether. In the Clinic we endeavor to avoid anoxemia and, therefore, we often use ether in small amounts in order to produce relaxation as well as anesthesia. The frequency with which ether was used when a gas was combined with local anesthesia will be noted in the remarks on ethylene and nitrous oxid.

CHLOROFORM

The use of chloroform was discontinued in 1927, and it is not likely to be reintroduced unless a different technic of administration is employed. For several years it was used only in connection with the operation for the repair of harelip or cleft palate.

ETHYL CHLORID

In the tabulation the data referring to ethyl chlorid indicate the extent to which it was used as a general anesthetic, either alone for short anesthesia or for rapid induction to be followed by ether anesthesia. Ethyl chlorid is a good anesthetic. I believe that its field of usefulness will increase as its physiologic effect is better understood.

OIL-ETHER COLONIC ANESTHESIA

Oil-ether colonic anesthesia was used in more cases in 1927 than in either of the two previous years. Any difficulties encountered in the use of the method during the year were of minor importance. Unless a more convenient method is developed for anesthetizing the selected patients on whom oil-ether colonic anesthesia is used, or unless some unforeseen accident or accidents occur in the use of this method, I would expect to see it used in about the same number of cases in 1928 as in 1927. Intratracheal anesthesia is the most likely competitor for the popularity of oil-ether colonic anesthesia.

CARBON DIOXID

Carbon dioxid was used about twice as often in 1927 as in 1926, and I would expect it to be increased in 1928. From time to time additional equipment has been installed permitting the use of carbon dioxid, with the result that its use will continue to increase until it has been made available for a certain period to those who may have use for it. I believe that it is an invaluable agent and that it should be available on each gas machine.

NITROUS OXID

Nitrous oxid was used in a larger number of cases in 1927 than in any of the preceding five years. In some cases it was used throughout the anesthesia, but in many it was used simply for induction to ethylene. I believe its use will have increased in 1928, probably at the expense of ethylene. Certain surgeons are inclined to favor nitrous oxid over ethylene in combined anesthesia for operations on the thyroid gland, and others favor it because it is less likely to explode than ethylene. In about half of the cases in which nitrous oxid was used without local anesthesia, ether was added in order to produce relaxation without anoxemia. In about four-fifths of the cases in which nitrous oxid was used with local anesthesia, ether was added.

ETHYLENE

I have tried elsewhere to sum up the general opinion of ethylene.[4] I believe that although ethylene is a good anesthetic agent, it falls short of the ideal. I would regret to see ethylene discarded; however, I know that we could get along without it, especially if carbon dioxid is available. The most outstanding decline in the use of ethylene has been in connection with operations on the thyroid gland. It is still used in these cases, but less extensively than formerly. The fact that there has not been an explosion with ethylene in the Clinic has forestalled the elimination of it on that score. There was, however, a slight decrease in the use of the gas because of reports of explosions elsewhere. In about four-fifths of the cases in which ethylene was used without local anesthesia, ether was added. In about one-fifth of the cases in which ethylene was used with local anesthesia, ether was added. These cases include those in which nitrous oxid was used as an induction for ethylene.

METHODS AND APPARATUS

In August of 1927 the intratracheal method of anesthesia was reintroduced and was used in a few cases in connection with operation for intrathoracic tumor. I believe that it will have been used more in 1928, although two or three years may be required before this method will reach the popularity it deserves. In practically all instances, anesthesia was maintained principally with ether, and nitrous oxid or ethylene with oxygen was used as a vehicle. A single intratracheal tube was used and a gas machine was used as a power unit for the insufflation.

In the autumn of 1927 a decided improvement was effected in safeguarding patients against the accidental administration of gases other than oxygen when the use of oxygen was intended. The following simple scheme (Fig. 48) sufficed: The porthole in the valve of the oxygen cylinder was enlarged by 0.4 mm. The strainer nipple in the oxygen yoke of each gas machine was correspondingly enlarged, with the result that nothing but an oxygen cylinder could be used in an oxygen yoke. It is the strainer nipple in the yoke of a gas machine that fits into the

porthole in the valve of any gas cylinder. The air-tight fit is accomplished, however, by forcing the face of the valve up against the lead washer, which is held in place by the strainer nipple against the face of the yoke. The strainer nipple simply acts as a guide for the porthole in the valve. This has effectively eliminated the danger of putting a cylinder of nitrous oxid or other anesthetic gas on the oxygen side of the machine with the possibility of attending disaster. The slight enlargement of the porthole in the valve of the oxygen cylinder in no way

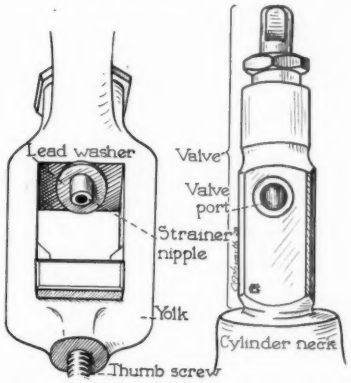


FIG. 48.—Strainer nipple in yoke of gas machine and porthole in cylinder. The porthole in the valve of the oxygen cylinder is enlarged 0.4 mm. The corresponding strainer nipple is also enlarged 0.4 mm.; thus no other cylinder will fit this connection.

interferes with its use on an ordinary apparatus, so there is no loss. In the same way the larger strainer nipple can be screwed into or out of the hole where the smaller one usually goes. Again there is no loss. Sooner or later I shall apply some variation of this scheme to the valve in the carbon dioxid cylinders. I believe that the plan has worked with such satisfaction at The Mayo Clinic that its use may be found advantageous elsewhere.

At last satisfactory results are being obtained in preparing dilute procain-epinephrin solution for local anesthesia. Ampules of concentrated procain solution, ampules of dilute epinephrin, and freshly prepared physiologic sodium chlorid solution are

being used. The mixing is done by the regional anesthetist at the last possible moment, and this has eliminated several unpleasant and undesirable experiences during the induction of local anesthesia. In this way one can be sure of getting the proper anesthetic of the proper dilution, and of having it at the right temperature and also sterile. The question of adding epinephrin is considered for each patient, and its omission if it is contraindicated is more certain than it otherwise might be.

I have been fortunate in obtaining very short, $\frac{1}{3}$ to $\frac{1}{2}$ inch, fine wheal needles for making the first injection of a local anesthetic into the skin. The short needle (Fig. 49, *b*) is far superior

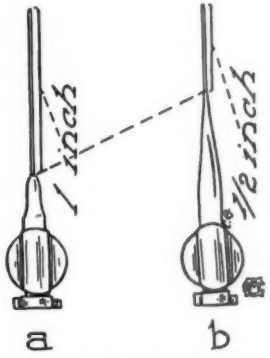


FIG. 49.—Wheal needles. *a*, The long wheal needle. *b*. The short wheal needle, which is more satisfactory for making the first injection of a local anesthetic into the skin. In *a* there is considerable back pressure when one attempts to force solution through the needle. In *b* there is little back pressure.

to the long wheal needle (Fig. 49, *a*) now in general use. I have discarded the longer wheal needle.

The various changes that are apparent on examination of the data in Tables 1 and 2 have made it easier to produce anesthesia with greater satisfaction to the surgeon, the patient, and the anesthetist with each succeeding year. Without doubt the results in 1927 were the most satisfactory since 1922.

BIBLIOGRAPHY

1. Isenberger, R. M., and Lundy, J. S.: Investigations of untoward reaction in relation to local and spinal anesthesia. Proc. Staff Meet., Mayo Clin., 1928, iii, 294–297.

2. Lundy, J. S.: Experience with anesthesia in 1925. Current Res. Anesth. and Anal., 1927, vi, 38–42.

3. Lundy, J. S.: Anesthetics used in the Mayo Clinic in 1926, especially oil-ether colonic anesthesia. Surg. Clin. N. Amer., 1927, vii, 1617–1625.

4. Lundy, J. S.: Ethylene as an anesthetic. Hosp. Prog., 1928, ix, 376–380.

5. McCuskey, C. F., and Rankin, F. W.: Spinal anesthesia for operation on the colon. (Unpublished data.)

CASES FROM THE CLINIC OF STUART W. HARRINGTON

STUART W. HARRINGTON

PHARYNGO-ESOPHAGEAL DIVERTICULUM

Case I.—A man aged sixty-four years came to the Clinic September 13, 1928, complaining chiefly of dysphagia. Difficulty in swallowing and a sensation of a pocket in his throat which filled whenever he swallowed food or liquid had been progressive for the last seven or eight years. If saliva was not swallowed it lodged in the pocket and was coughed up. Solid food and liquid lodged in the throat until the pocket was filled and then progressed to the stomach. Moderate tickling in the throat when the pocket was full caused coughing and regurgitating of food. If the patient was unable to empty the pocket the food became foul and was sometimes streaked with blood when it was coughed up. Slight choking attacks occurred at night due to the accumulation of saliva in the throat. He was awakened with considerable coughing. He was conscious of dull discomfort in the throat and a peculiar gurgling sound on swallowing. It was necessary to cough and clear the throat almost constantly.

Roentgenogram showed a small diverticulum of the upper third of the esophagus (**Fig. 50**). Esophagoscopy showed a pharyngo-esophageal diverticulum without obstruction below the diverticulum. A two-stage operation was advised.

The first stage of the operation was performed September 18. An incision was made along the anterior border of the sternocleidomastoid muscle, the omohyoid muscle cut, and the esophagus exposed. A diverticulum was found extending slightly to the left at the juncture of the pharynx and esophagus. The sac was entirely separated from the surrounding structures, brought through the wound, and the skin sutured around the neck of

the sac leaving the sac attached to the esophagus entirely outside of the skin (Fig. 51). September 25 the second stage of the

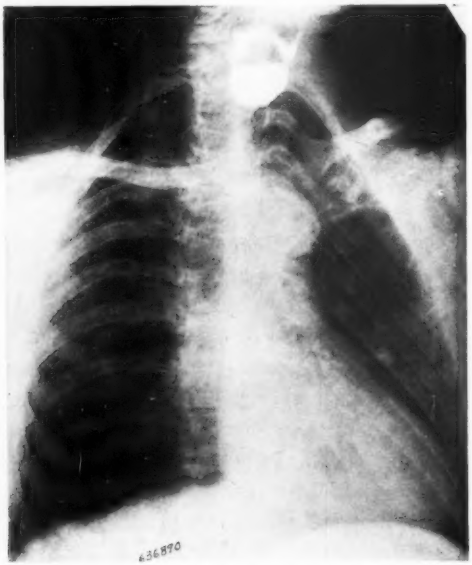


FIG. 50.—(Case I.) Moderate sized diverticulum of the upper third of the esophagus.

FIG. 51.—(Case I.) Completion of the first stage of the operation; neck of diverticulum sutured to skin on the left side.

operation was performed. The original incision was separated so as to expose the esophagus and the neck of the sac, which was ligated with chromic catgut; the stump was then inverted and closed over with interrupted silk sutures. The wound was completely closed.

Convalescence was uneventful. The esophagus did not leak, but the wound sloughed slightly at the site where the diverticulum had been brought out through the skin; this healed readily. The patient was dismissed from observation October 12, 1928, with the wound entirely healed. He did not have difficulty in swallowing, and was entirely relieved of symptoms (Fig. 52).

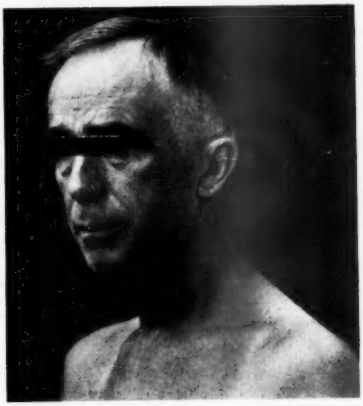


FIG. 52.—(Case I.) Wound entirely healed after two-stage operation for esophageal diverticulum.

The clinical syndrome of diverticula of the esophagus is fairly characteristic, but the diagnosis is substantiated by the use of roentgen rays or the esophagoscope. From the etiologic standpoint, there are two types of diverticula: (1) Traction diverticula resulting from contracting scar tissue outside of the esophagus and usually seen around the hilum of the lung due to scar tissue resulting from broken down lymph nodes, and (2) pulsion diverticula which are probably more common and are situated in the lower part of the pharynx just above the esopha-

gus, or the upper third of the esophagus, but in reality are diverticula of the pharynx. These occur in the posterior wall of the pharynx at the level of the coracoid cartilage in the area of muscular deficiency on the posterior wall. This type of diverticulum may also occur in the lower third of the esophagus with a formation similar to that in the upper part of the esophagus and there may be an area of muscular deficiency in the esophagus above the cardiac opening in the stomach. These diverticula may become adherent to the lung, rupturing into the parenchyma and producing bronchial fistulas, thus making a free communication between the esophagus and the lung. Although this type of diverticulum is rare, it is in reality the more common type of true esophageal diverticulum, since the greater proportion of diverticula of the upper part of the esophagus originate in the lower part of the pharynx. They are usually termed "esophageal diverticula" because the symptoms are related to the esophagus.

Operative results in cases of diverticula of the upper part of the esophagus are very satisfactory. The operative risk in cases of diverticula of the lower part of the esophagus is much greater because they require a transpleural approach and are often complicated by mediastinitis or suppurative pleuritis. Cases in which the diverticulum has ruptured into the lung require treatment as for lung abscess. The sac in these cases is usually best cared for by ligating the neck, dissecting it through, and inverting the stump into the lumen of the esophagus, and suturing the wall of the esophagus over the inverted stump. The patient is fed through a duodenal tube, which is placed in the stomach or duodenum before the operation, until the diverticulum has been removed and the wound is healed. Recurrences are rare if the sac is removed close to the esophagus.

MECKEL'S DIVERTICULUM

Case II.—A man aged sixty-seven years admitted February 6, 1928, complained chiefly of bowel trouble. One year previously he had had a severe attack of lower midabdominal pain radiating to both lower quadrants. The pain lasted several

hours and was relieved by hot-water bottles. The following day a large amount of blood was passed from the bowel three times. He remained in bed for several days because of weakness. He worked all summer with only mild occasional distress in the lower part of the abdomen. Diarrhea or loss of weight had not occurred, but occasionally he found blood in the stool.

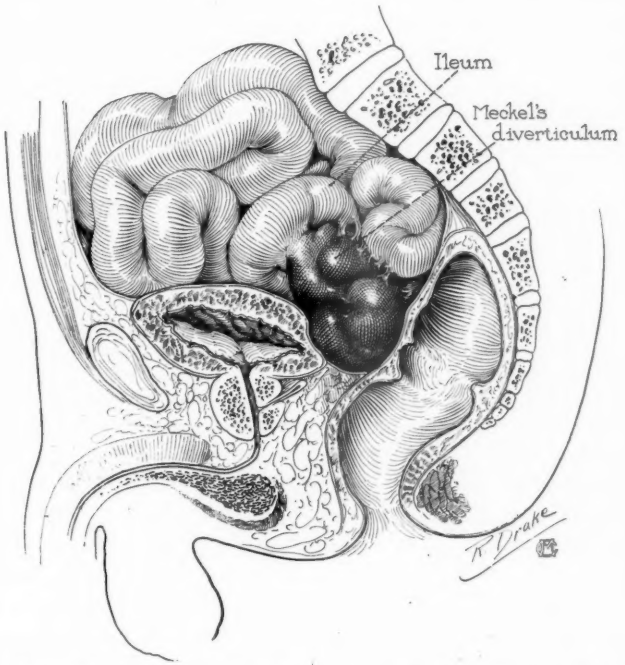


FIG. 53.—(Case II.) Position of gangrenous Meckel's diverticulum with multiple perforations in small bowel, rectosigmoid, and base of bladder.

Six months before admission, recurring attacks of sharp pain in the lower part of the abdomen began, lasting about two hours. A hot-water bottle had been used for relief. The patient was weak, and lost weight progressively. Constipation required the constant use of laxatives.

The hemoglobin was 69 per cent, and the leukocytes num-

bered 7,900. Roentgenologic examination of the stomach was negative. A roentgenogram of the colon showed deformity of the rectum, probably extrinsic. Proctoscopic examination disclosed a mass extrinsic to the rectal mucosa, probably metastatic. The patient had lost 20 pounds.

Operation was performed February 11, 1928. A pelvic incision was made in the median line. Many loops of small bowel were found adherent in a mass between the bladder and rectum in the lowest portion of the abdomen. After these loops of bowel were separated it was found that the first portion of the terminal part of the ileum was retrocecal. On exploring the proximal part of the ileum an extension of the neck of the diverticulum was encountered (Fig. 53). This was found to be a large inflammatory mass 6.25 by 5 cm. filled with hard fecal material, which had perforated into several loops of small bowel into the rectosigmoid (undoubtedly the cause of the rectal bleeding) and onto the base of the bladder. The many perforations were repaired and the diverticulum was removed. The portion of the bowel proximal to the neck of the diverticulum was markedly inflamed, thickened, and edematous and the opening of the diverticulum was closed transversely, a fair lumen of the bowel being maintained. Because of the inflammatory reaction of the bowel it was thought best to perform entero-anastomosis above and proximal to the closure. After these many openings in the large and small bowel and base of the bladder had been closed, drains were inserted into the abscess pocket.

The patient stood the operation very well, but, as would be expected, his convalescence was stormy because of the infection and the magnitude of the operation. On the ninth day after operation an intestinal fistula developed, probably from the site of the closure of the opening after resection of the diverticulum or it may have been from one of the perforations which had been repaired in the bowel. Drainage gradually subsided in about two weeks. The bowels moved daily without the aid of enemas. The patient had gained about 12 pounds and the wound was practically healed, nine weeks after operation. He is now doing heavy work and is entirely free from symptoms.

Meckel's diverticulum is a result of failure of complete obliteration of the vitelline duct which normally should close in the seventh week of fetal life. It is usually found about 3 feet (1 meter) from the ileocecal coil. Meckel's diverticulum is of interest because of its infrequency and the rarity with which it is diseased and the cause of symptoms. It has been variously estimated to be present in 0.5 to 2 per cent of persons. Most of these estimations have been made during anatomic studies, where it is noted much more often than at the operating table. It has been variously estimated that Meckel's diverticulum is found at operation in one in 250 to one in 600 abdominal operations. Most statistics are valueless because few surgeons make a routine examination for the presence of a Meckel's diverticulum. I believe such examination should be made in cases of chronic appendicitis or of indefinite abdominal complaints in which a pathologic lesion cannot be found to explain the symptoms. A clinical diagnosis of Meckel's diverticulum is not common. In most instances the diagnosis is made at the time of operation; it is usually associated with intestinal obstruction, intussusception, diverticulitis, and hernia.

The case reported here is of interest because of: (1) The age at which the symptoms appeared; (2) the clinical symptoms suggesting malignancy of the bowel; (3) the hard firm mass back of the rectum which was suggestive of metastatic carcinoma; and (4) the multiplicity of complications in which the diverticulum caused perforation of several loops of small intestine, as well as the rectosigmoid and the base of the bladder, indicating a long-standing chronic infection which the surrounding tissues gradually walled off without producing complete obstruction to the bowel. The symptoms were slight frequency and a moderate amount of pus in the urine. It was difficult, even after separation of loops of adherent perforated large and small bowel from the tumor, to determine the etiologic factor.

BILATERAL CARCINOMA OF THE BREAST

Case III.—A woman aged forty-six years accompanied her husband who came to the Clinic for examination. She decided

to be examined also, chiefly because of a discharge from both breasts which had been present for the last three or four years. She had been told that this was not of serious significance. The discharge was usually watery and at times bloody but never purulent; it was watery on the left side and bloody on the right side. The breasts were painful at the time of the discharge which was last noticed about eight weeks previously.

Examination showed slight diffuse thickening throughout both breasts. Definite tumors were not palpable. The urine and blood were normal. Roentgenogram of the chest showed that the heart was slightly enlarged to the left. A diagnosis was made of bilateral intraductal papilloma, probably with malignant degeneration.

Because of the bloody discharge from the right nipple, simple amputation of the right breast was first performed and the tissue immediately examined. It was found to be a carcinomatous papilloma, 2 mm. in diameter, with invasion into the surrounding tissue. Radical amputation followed immediately. Simple amputation of the left breast was then performed. A carcinomatous papilloma, 3 mm. in diameter, had invaded into the surrounding tissue and the operation was immediately completed as a radical amputation with removal of the pectoralis minor, greater portion of the pectoralis major, and complete axillary dissection.

The postoperative convalescence was without incident. The patient was given one course of roentgen-ray treatment and was dismissed from observation three weeks following the operation (Fig. 54). There was moderate limitation of motion of both arms but function was at least 75 per cent normal and it is anticipated that this will improve markedly in the next six months.

This case is of unusual interest because of the presence of primary carcinoma in both breasts at the same time as well as the probability of malignant degeneration even though a tumor was not palpable. It also emphasizes the importance of considering an abnormal discharge from the breast, either bloody or watery, as of possible serious significance. Such a discharge may be due, at the onset, to a benign intraductal papilloma, but

the presence or absence of malignant degeneration can only be determined by microscopic examination of the tissue. The age of the patient is not a criterion as to the possibility of malignant degeneration of the papilloma. I recently operated on a patient aged thirty-two who had had a bloody discharge from the right nipple after nursing a child. The breast became congested and nursing was stopped. The bleeding continued for six months.

FIG. 54.—(Case III.) Bilateral radical amputation; wounds on dismissal three weeks after operation.

Simple amputation was advised and an intraductal papilloma with malignant degeneration and infiltration of the surrounding tissue was found. The operation was completed as a radical procedure. Lymphatic involvement was not found. In the childbearing period the early surgical treatment of such growths is very important because if they are not cared for and pregnancy develops subsequently, there is grave danger that a fulminating

type of malignant growth may develop for which treatment will be of little avail.

BILATERAL PRIMARY CARCINOMA OF THE BREAST WITH AN INTERVAL OF TWENTY-FIVE YEARS BETWEEN OCCURRENCES

Case IV.—A woman aged fifty-one years came for consultation September 6, 1928 because of a tumor of the left breast. The tumor had been first noted about a month previously at which time it measured about 5 cm. in diameter. Since that time, it had doubled in size, with slight aching pains. In 1903, radical amputation had been performed at the Clinic for carcinoma of the right breast. There was no history of tuberculosis or malignancy in the family.

FIG. 55.—(Case IV.) Bilateral radical amputation.

Examination disclosed a large firm tumor in the upper outer quadrant of the left breast, attached to the skin and with palpable lymph nodes in the axilla. The urine and blood were normal. A roentgenogram of the chest showed healed tuberculosis in the right apex. A diagnosis was made of carcinoma of the left breast with metastasis to the axilla.

Radical amputation of the left breast was performed September 11, 1928, and extensive carcinoma with lymphatic involvement, graded 4, was found. Convalescence was uneventful and the patient was dismissed October 15. She returned November 13 with the wound entirely healed and without evidence of local recurrences or distant metastasis. Swelling was not present and function of the arm was good (Fig. 55).

This case is of interest because of the occurrence of a primary carcinoma of the left breast, twenty-five years after the operation on the right breast for carcinoma. There is little if any doubt that both lesions were primary, in the absence of evidence of local recurrence in the right breast; the scar was perfectly healed, and the axillary and supraclavicular nodes were not enlarged on that side, although there was axillary involvement at the time of the first operation. The only demonstrable evidence of distant metastasis at the second operation was in the left axilla.

EMPYEMA OF THE RIGHT SIDE OF THE THORAX, PLEURAL EFFUSION IN THE LEFT SIDE, AND PURULENT PERICARDITIS

Case V.—A man aged twenty-seven years was brought to the Clinic in an ambulance April 24, 1928. He complained chiefly of dyspnea. The illness had begun about six weeks previously with pneumonia. The crisis was slow and incomplete. Eight days after the onset of this acute illness a pericardial rub developed and later physical signs of fluid in the pericardial cavity appeared and muffling of the heart sounds and disappearance of the pericardial rub. After medical treatment the heart sounds became more distinct and the pericardial rub returned. The temperature had been septic for the last two weeks with increased pulse rate and labored respiration. There had been signs of fluid on both sides of the thoracic cavity with marked dyspnea and cyanosis, and the pulse had been rapid and feeble for the last forty-eight hours.

On examination the patient was found to be very weak and dyspneic. There was considerable pain on respiration, particularly inspiration, and marked cyanosis. The respiratory rate was

from 40 to 44, and the pulse rate varied between 130 and 140. The systolic blood pressure was 85 and the diastolic 60. The temperature was 101° F. Erythrocytes, pus, and granular casts were found in the urine. The leukocytes numbered 11,000. Roentgenograms of the chest revealed encysted fluid in the right side of the thorax, and probably fluid in the left; the heart was considerably enlarged on both sides (Fig. 56). A diagnosis was made of empyema of the right side of the thorax, pleural effusion in the left side, and acute purulent pericarditis.

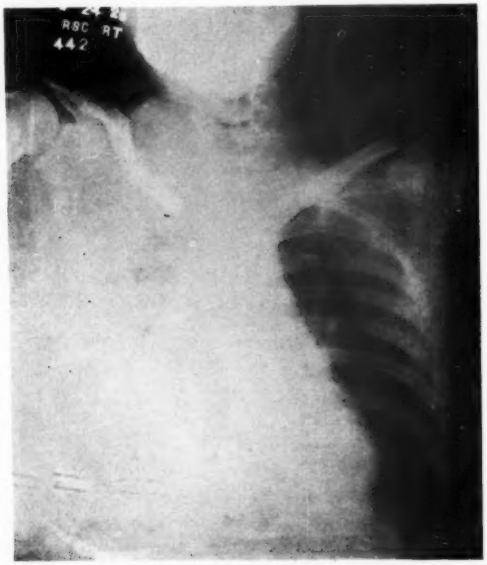


FIG. 56.—(Case V.) Encysted fluid in right side of thorax and probably left side; marked enlargement of the pericardium on both sides; pericardial effusion.

April 25, 2.5 cm. of the seventh rib (in the posterior axillary line) was resected and drainage was instituted through the posterior periosteum by insertion of a No. 30 French catheter. About 1,500 c.c. of thick foul-smelling pus was removed, which on bacteriologic study was found to contain Type I pneumococcus. Digital exploration of the pleural cavity showed a multilocular

type of empyema cavity. April 26, diagnostic aspiration was performed because of pleural effusion in the left side. About 500 c.c. of clear amber-colored fluid was removed from the left side of the thoracic cavity. April 28, anterior pericardotomy was performed with resection of the sixth intercostal cartilage for drainage of purulent pericarditis; 500 c.c. of thick greenish foul pus was removed. The heart was covered with fibrinous

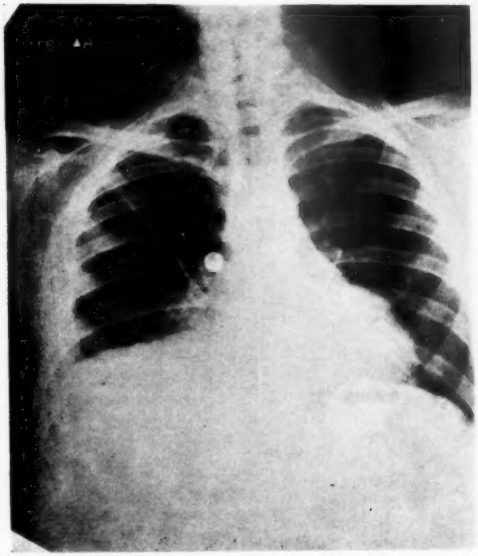


FIG. 57.—(Case V.) Heart shadow practically normal; complete re-expansion of lung; thickened pleura at the base with intralobar band, two and a half months after operation.

exudate and was adherent to various points of the pericardium causing encysted pockets of pus throughout the pericardium. Many of these adhesions were broken through to convert the pockets into one large cavity. Bacteriologic examination of the pus showed Type I pneumococcus and Gram-positive cocci.

The right pleural cavity and the pericardial cavity were first irrigated with sodium chlorid solution and later with Dakin's solution. Convalescence was stormy for the first three

weeks and then the patient gradually began to improve. The temperature dropped to normal, but for a period of two and a half weeks fever appeared periodically, as a result of inadequate drainage of multilocular empyema pockets in the right side of the thorax. The infectious material was gradually recovered from these pockets by irrigation with Dakin's solution, and after the seventh week the temperature remained normal.

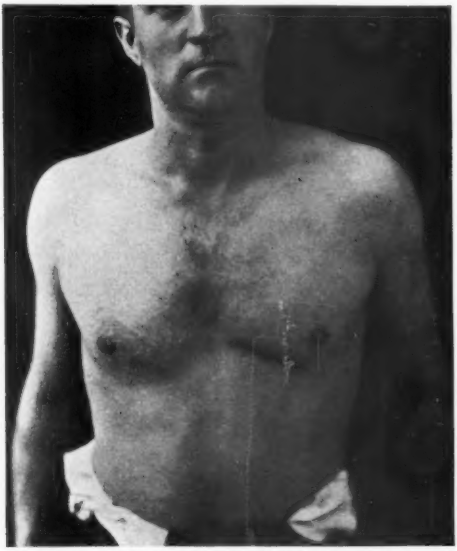


FIG. 58.—(Case V.) Wound in pericardium healed.

The pericardial cavity continued to drain purulent material for six weeks after which the drainage became slightly serosanguinous; the wound was entirely healed in eight weeks. The empyema cavity drained for nine weeks when it was entirely healed. During this time the patient gained 15 pounds and the general condition was excellent (Figs. 57 and 58).

This case is unusual in that the patient had enough resistance to withstand a very serious type of pneumonia with complications in all three serous cavities. In the pericardium

and right side of the thorax the effusion was purulent, and in the left side of the thorax it was serous. From a surgical standpoint it exemplifies the importance of multiple operations if the patient is very sick and the importance of obtaining adequate drainage with as little operative interference as possible. The right side of the thorax was aspirated in three different areas and pus was obtained from only one area; it was very thick and entered the aspirating syringe with difficulty. From this it was determined that the condition was probably due to many encysted pockets, and a rib was resected following which the septums between several pockets were broken by digital exploration in order to obtain adequate drainage. After the patient's condition had improved this was again necessary in order to drain several isolated encysted pockets. The thorax was drained first because the patient was in extremis on admission, his chief difficulty being dyspnea from lack of lung capacity due to compression of both lungs, on the right by pus and on the left by serous effusion. The right side was drained first because it not only relieved the compressed lung but removed a part of the septic process, and the pericardium was aspirated with removal of about 100 c.c. of thick pus which helped to relieve cardiac embarrassment. The patient was placed immediately in the oxygen tent. Roentgenograms of the right side of the chest showed it to be partially reëxpanded and the fluid was then withdrawn from the left side with the aspirating needle, negative pressure in the thorax being maintained. Two days later, sufficient improvement had occurred to permit drainage of the pericardial cavity. Anterior operation was performed, and a portion of the sixth rib was removed. The pericardial cavity was opened and found to contain about 500 c.c. of pus in multilocular cavities; these were broken down with the finger into one cavity for adequate drainage. The patient was kept in the oxygen tent for eight days, and after that only periodically. Symptomatic treatment was instituted as indicated. Roentgenogram taken two and a half months after operation showed the heart shadow to be practically normal with complete reëxpansion of the lungs, and thickened pleura at the right base with an interlobar band.

The patient's condition is excellent. He has gained 15 to 20 pounds and is doing light work.

PULMONARY TUBERCULOSIS

Case VI.—A woman aged twenty-one years came to the Clinic July 19, 1928 complaining chiefly of marked cough, bloody expectoration, afternoon temperature, and dyspnea. She had been apparently in good health except for chronic cough until May, 1927 when sudden spontaneous pneumothorax and diffuse pulmonary hemorrhage occurred. She suffered extreme dyspnea and pain in the right side of the chest, and was acutely ill. She was taken to the hospital immediately where she remained for about a month. Morphin was given for pain for about ten days. Bacilli of tuberculosis were found in the sputum. After leaving the hospital she went to a camp for three months and, in September, 1927, to a sanatorium. She was given artificial pneumothorax in the sanatorium for nine months. The pneumothorax was not satisfactory because of adhesions. The last bloody sputum was noted in January, 1928. She had gained about 5 pounds in one year at the sanatorium. She had had a constant cough with much expectoration in the morning. Afternoon fever was present most of the time. Pain in the chest had not occurred recently, but she was dyspneic, and 10 pounds underweight.

On examination the patient appeared to be fairly well nourished; her cheeks were flushed. The systolic blood pressure was 110, the diastolic 70, the pulse rate 96, and the temperature 100.2° F. at 4 p.m. The heart was drawn to the right. The right lung expanded only slightly. The right apex was retracted. Tactile and vocal fremitus were increased over the entire right lung. Tubular breathing and a profusion of moist râles were noted throughout the entire right lung. Urinalysis was negative. The hemoglobin was 60 per cent; erythrocytes numbered 3,930,000 and the leukocytes 9,500. The sputum contained the bacilli of tuberculosis. A roentgenogram of the chest showed extensive tuberculosis of the right lung; dense pleuritic thickening of the right base with marked retraction of the right lung

was shown (Fig. 59). The heart and the mediastinum were drawn markedly to the right. A few old healed tuberculous scars were present at the left apex. Surgical collapse of the right lung by thoracoplasty and phrenicotomy was advised.

Preliminary phrenic evulsion was performed August 1, 1928. On exposing the right phrenic nerve a large mass of tuberculous lymph nodes of the lower deep cervical group was encountered. There was a moderate amount of bleeding on evulsion of the

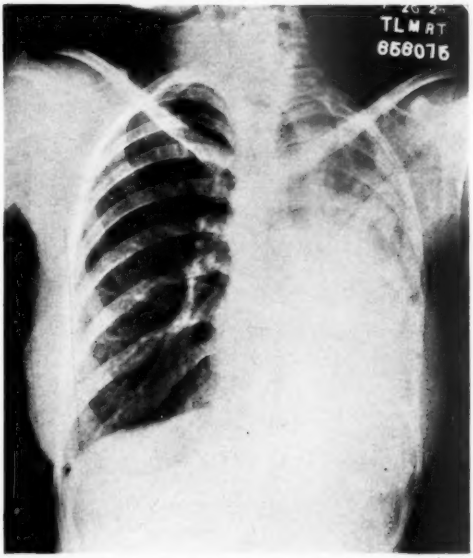


FIG. 59.—(Case VI.) Tuberculosis on the right side with marked retraction of right lung and dense pleuritic thickening of right base.

nerve. Convalescence was uneventful following this procedure and, August 4, complete right extrapleural thoracoplasty was performed in one stage. The ribs were markedly thickened and triangular in shape, giving evidence of marked pleural involvement. Three centimeters of the first rib, 5.5 cm. of the second rib; 9 cm. of the third, fourth, and fifth ribs, and 10 cm. of the sixth, seventh, eighth, ninth, and tenth ribs were removed. The

blood pressure remained the same throughout the operation, although the pulse increased from 100 to 130 with a slight fall in blood pressure at the close of the operation. Intravenous injections of sodium chlorid solution were given immediately after operation (Fig. 60).

Convalescence was uneventful. The pulse was 130 the day following the operation and the temperature was 100.5° F.

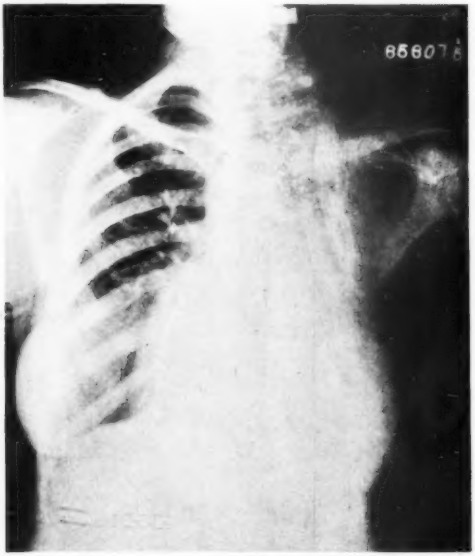


FIG. 60.—(Case VI.) Practically complete collapse of right lung two weeks following one-stage extrapleural thoracoplasty.

Temperature and pulse gradually dropped, and on the fifth day the temperature was normal, and the pulse was 110. The pulse dropped to 100 on the ninth day, and this was approximately maintained throughout convalescence. The patient was sent back to the sanatorium twenty-two days after the operation. The wound healed by primary intention and she had been entirely free from an increase in temperature for two and a half weeks prior to dismissal (Fig. 61).

The disease of the right side was extensive with multiple cavities and considerable fibrosis. The heart was drawn completely into the right thorax. Little benefit was obtained from pneumothorax because the adhesions permitted incomplete collapse of the lung. Since the left lung was fairly free from disease, a complete collapse of the right lung seemed to be indicated. This could not be accomplished by pneumothorax, and surgical intervention was therefore advised. The preliminary right

FIG. 61.—(Case VI.) Appearance of wound three weeks after operation.

phrenicotomy was performed in order to fix the diaphragm and also to test the patient's ability to withstand operation. There was practically no reaction, and three days later complete thoracoplasty was performed. I decided to do the complete thoracoplasty in one stage if possible, because the collapse of the lung would be more complete which, in this case, was especially indicated in view of the multiple fibrinous cavities, and the marked fibrosis and thickening of the pleura. I do not believe that the

extent of the operative procedures can be decided entirely before operation. A general examination and preliminary phrenicotomy will determine, to a certain extent, the patient's ability to withstand surgical procedures, but the final decision must be made at the operating table. Blood pressure readings should be taken every three to five minutes and the fall of the pulse pressure noted. If the pulse pressure drops 10 mm. of mercury, the operation should be terminated as soon as possible. As a rule it is rarely advisable to prolong the operation longer than thirty minutes at one stage. If the complete operation can be performed in that length of time, and the patient's condition remains satisfactory, the operation should be completed, but if not, it should be stopped and completed at a subsequent time.

DIAPHRAGMATIC HERNIA

Case VII.—A man aged thirty-five years came for consultation October 4, 1928, because of stomach trouble. In July, 1920, he fell from a 16-foot embankment landing on his feet on a cement floor. He fractured one bone in the right leg, and tore the ligaments of the left leg. Both legs were placed in splints for four weeks. He was unable to work for eight weeks. During this period he experienced mild indigestion immediately after meals, but this was attributed to constipation and inactivity. One and a half years later he felt the pain in the left side of the chest after meals and simultaneously pain in front of the left shoulder. This had been progressive and was associated with dyspnea on exertion. About six years before admission the gastric distress became more or less constant, particularly following a heavy night meal. The pain in the chest and shoulder, and the dyspnea were also present. In April, 1926 he had a severe attack lasting a week with nausea, vomiting, and cramping pains in the stomach, and severe pain in the left shoulder. Since then he had had repeated attacks of similar pain coming on usually from one to two hours after meals and lasting until the next meal. A glass of milk or solid food would cause pain in the left side of the chest through to the angle of the scapula, and pain in the left shoulder radiating down the left arm. In July, 1928 he vomited

a large quantity of blood and thought he passed blood in stools. He was placed on a Sippy diet in a hospital and improved slightly. He had lost 40 pounds in weight.

The systolic blood pressure was 105 and the diastolic 60. The hemoglobin was 71 per cent, the erythrocytes numbered 4,520,000 and leukocytes 6,100. Gastric analysis showed total acidity 42, and free hydrochloric acid 24 in 100 c.c. of content. Roentgenograms of the stomach and chest revealed almost the entire stomach above the diaphragm (Fig. 62). Fluoroscopic

FIG. 62.—(Case VII.) Left traumatic diaphragmatic hernia with almost entire stomach in left thorax extending to the fifth rib.

examination of the chest showed a large opening in the left dome of the diaphragm posterior to the esophageal opening. A diagnosis of large left diaphragmatic hernia probably of traumatic origin was made and operation advised.

Operation was performed in two stages. At the first operation, October 10, 1928, preliminary left phrenicotomy was per-

formed to relax the left half of the diaphragm. Three days later, under intratracheal anesthesia, the opening in the left half of the diaphragm was repaired through an abdominal approach.

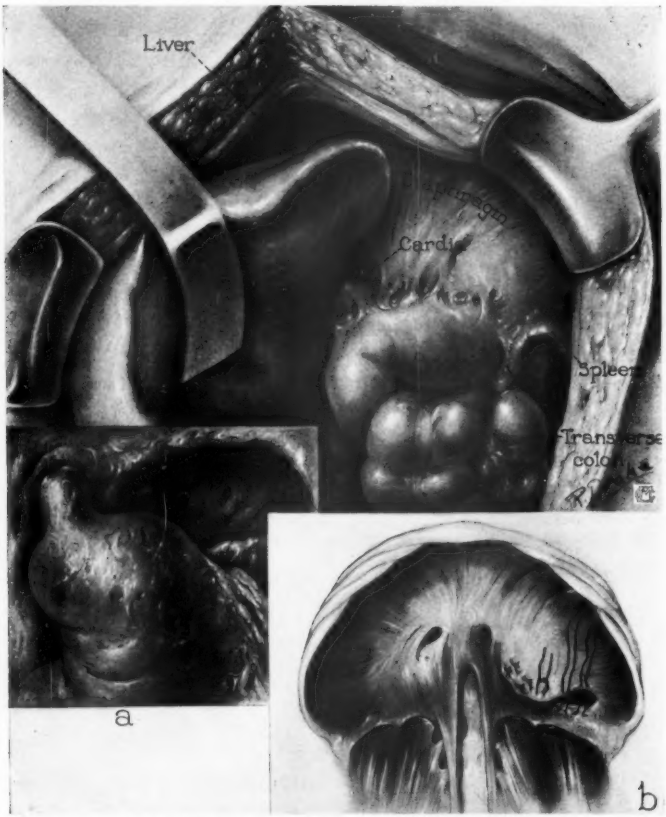


FIG. 63.—(Case VII.) Large left traumatic diaphragmatic hernia with almost entire stomach in left thorax; *a*, Stomach removed from thoracic cavity following separation of adhesions; *b*, closure of the large opening in the diaphragm.

On exposing the upper part of the abdomen extensive adhesions were found around the diaphragm, and only about 5 cm. of the pyloric end of the stomach was in the abdominal cavity. The

remaining portion was in the left part of the thorax, together with the omentum and a portion of the transverse colon. The omentum and stomach were firmly adherent to the margins of the opening in the diaphragm, which was elliptical in shape and about 10 cm. in diameter, extending from about 2.5 cm. to the left of the esophageal opening downward and backward. After the adhesions had been freed from the margins of the opening the colon could be reduced from the thoracic cavity, but the stomach and omentum could not be brought into the abdominal cavity because of firm adhesions to the pericardium and the under surface of the lung. It was necessary to dissect the entire stomach from these structures. A portion of the omentum could not be entirely removed without injuring the pericardium and lung; it was, therefore, ligated and left in the thoracic cavity. There was marked scarring of the stomach on the lesser curvature at the angle where it rested against the ring of the hernia with evidence of an area of shallow, traumatic ulceration due to the angulation of the stomach. After the abdominal viscera had been replaced in the abdomen, the large elliptical rent in the diaphragm was repaired by overlapping the anterior portion of the posterior margin for a distance of about 2 cm. Satisfactory closure of the diaphragm was obtained with interrupted linen sutures (Fig. 63). A few interrupted catgut sutures were placed in the stomach to reinforce the thinned area where the stomach had been angulated through the opening, and the abdomen was closed without drainage. Convalescence was uneventful. The gastric complaints have been entirely relieved (Fig. 64).

This case is of interest because the clinical history contained most of the important diagnostic points in the recognition of diaphragmatic hernia and exemplified how a clinical history may simulate that of a gastric ulcer, thus causing one of the common errors in diagnosis. The occurrence of diaphragmatic hernia is not uncommon, and may or may not be associated with trauma. The usual site of the opening is through one of the embryonic fusion points of the diaphragm or through the esophageal opening. The clinical symptoms depend to some extent on the size of the opening, and the amount and type of herniated ab-

dominal contents. Cases in which the stomach alone is involved present fairly characteristic syndromes which depend to some extent on the amount of herniated stomach. At the onset there is usually some mild indefinite gastric disturbance usually designated as indigestion. This consists of gastric distress usually immediately after meals accompanied by gas and pressure which often is present before the meal is completed. These symptoms are augmented by heavy meals and thus the patient often eats less, and more frequently. In the smaller types of hernia the

FIG. 64.—(Case VII.) Diagram slightly elevated one month following phrenicotomy and repair of opening; entire stomach below the repaired diaphragm.

diagnosis is difficult and rarely made except by roentgen-ray examination. Often mild cholecystitis is diagnosed. Unless the patient is placed in the dorsal position in making roentgenograms these small hernias may be overlooked. There are usually few if any symptoms referable to the chest in the smaller types of hernia, but there may be a reflex phrenic pain to the tip of the shoulder. The larger diaphragmatic hernias present the fore-

going symptoms, all of which are augmented and may be associated with a fairly characteristic ulcer syndrome as depicted in Case VII. The ulcer syndrome is caused by a shallow traumatic ulcer which in turn is caused by torsion and angulation of the stomach. There may be several gastric hemorrhages with melena, but they are not associated with the usual sensory exacerbations of typical ulcer nor is there the degree of food relief common in cases of organic ulcer. The latter types are often associated with severe attacks due to encarceration of the stomach in the thorax which may cause spasm of the diaphragm with reflex cardiospasm and pain radiating to the left shoulder, usually associated with marked dyspnea and bloating. These attacks are not uncommonly diagnosed as disease of the gallbladder or cardiac disease. They are immediately relieved by vomiting or gastric lavage, aided by release of the abdominal pressure by the use of enemas.

The treatment of diaphragmatic hernia is surgical and closure of the opening in the diaphragm offers the only permanent relief. This can be accomplished either through the thoracic or abdominal approach. I prefer the abdominal approach because there is no possibility of unknowingly injuring the abdominal viscera, and there are no thoracic complications. The small openings in the diaphragm can be closed readily in a normal diaphragm, but the large opening, if there is considerable loss of structure, cannot be closed without undue tension on the suture line; it is then best to perform preliminary phrenicotomy, thus relaxing the muscles of the diaphragm and permitting closure of the opening. If the hernia is extremely large and of the congenital type with marked loss of structure, it is necessary to narrow the cavity of the chest by posterior thoracoplasty. In the last three years I have operated in twenty-one cases without recurrence; one patient died from pneumonia in the opposite lung. In the remaining twenty cases, the results were very satisfactory.

A REVIEW OF 271 CASES OF MALIGNANT RENAL NEOPLASMS

VERNE C. HUNT AND BENJAMIN H. HAGER

CLINICAL data augmented by cystoscopic data have established dependable standards for the recognition of neoplasms of the kidney. Adequate treatment has not always been readily instituted, and with this in mind we have endeavored to review and to emphasize factors bearing on the longevity or mortality in cases in which nephrectomy is performed for malignant lesions of the kidney.

CLASSIFICATION

An introductory remark concerning the classification of renal malignancy seems warranted. We are cognizant of the lack of agreement in the nomenclature of renal neoplasms, and are desirous of so simplifying our analysis that the descriptions will be in accord with customary clinical usage. We have, therefore, divided malignant growths of the kidney into two groups, those originating in the renal cortex, and those originating in the renal pelvis. From anatomic and clinical standpoints, three solid malignant neoplasms of the cortex have been recognized: so-called hypernephroma or adenocarcinoma, alveolar carcinoma, and sarcoma. Foulds, in a careful summary of both anatomic and clinical material, presented various reasons for separating carcinomas of the kidney into the groups of adenocarcinoma and alveolar carcinoma. Braasch justifies this classification from his clinical experience. Robertson and Broders, however, recognize but one form of carcinoma and include all the solid epithelial tumors in the group of adenocarcinoma. They do not believe there is an anatomic reason for the differentiation of carcinoma of the kidney into adenocarcinoma and alveolar carcinoma, and that the only difference in the two is the degree of cellular dif-

ferentiation. The so-called hypernephroma may present the adenocarcinomatous picture or the alveolar carcinomatous picture. These two microscopic pictures may be present in the same neoplasm. The carcinoma which presents the acinose formation is more differentiated and less malignant than the one that presents the alveolar formation; the latter neoplasm is less differentiated, and therefore, is more malignant. Such interpretation need not detract from the clinical differentiation of the two, for we recognize in the group of so-called alveolar carcinoma, a history of rapid growth with pain or hematuria of relatively short duration, often for one or two years only. This is in contradistinction to the slow growth and relatively late appearance of hematuria and subjective symptoms in the cases of so-called hypernephroma or adenocarcinoma that has differentiated into acini.

TABULATION

	Patients.	Deaths in hospital.	Traced.		Nephrectomy.	Deaths in hospital.	Exploration.	Deaths in hospital.	Sinus curetted.
			Patients.	Per cent.					
Adenocarcinoma	225	21	199	88.44	177	18	22	3	
Sarcoma	10	1	8	80.00	7	1	1		
Malignant tumors in children	13		11	84.61	8		3		
Epithelioma of renal pelvis	23	1	23	100.00	22	1			1
Total	271	23	241	88.92	214	20	26	3	1

From January 1, 1918 to January 1, 1928 there have been performed at The Mayo Clinic 271 operations for malignant neoplasms of the kidney. Of these, 241 (88.9 per cent) of the patients were traced postoperatively, and the information was correlated with the pathologic and surgical data. The purpose was to determine in particular the relationship of surgical interference to morbidity and expectancy of life. The groups are

divided into adenocarcinoma, sarcoma, malignancy in children, and epithelioma of the pelvis of the kidney. For convenience they have been tabulated to indicate their distribution and the type of surgical interference. They will be considered in the discussion in the order in which they have been tabulated.

Adenocarcinoma.—So-called hypernephroma or adenocarcinoma heads the list in the classification with a total of 225 patients of whom 199 were traced. One hundred seventy-seven were subjected to nephrectomy and twenty-two to exploration. Of the 199, seventy-three are living and 126 are dead. Of the number on whom nephrectomy was performed sixty-two are living after a period of three years; thirty-seven, after a period of five years, and three, after a period of ten years. The hospital mortality in this group was twenty-one; of those on whom nephrectomy was performed, eighteen; of the explored, three.

Symptoms and diagnostic signs and their bearing on prognosis are not considered. In the group of adenocarcinomas, however, a tumor was palpable in 130 cases (65.98 per cent). Furthermore, of the patients with palpable tumors one lived eight years, seventeen lived five years, and thirty-four lived three years. Of those dead, ninety-two (74.19 per cent) had palpable tumors at the time of their examinations. It follows therefore that except for very extensive growths, the presence of a palpable tumor is not a criterion as to the ultimate results from nephrectomy. In one case the ureter was definitely involved as a result of extension of hypernephroma; there was one bilateral hypernephroma; in one case a hypernephroma was noted in a case of polycystic kidney in which both kidneys were polycystic; another hypernephroma occurred in an ectopic kidney.

The surgical approach for nephrectomy has been somewhat variable. A posterior lateral incision was employed in 133 (75.14 per cent), and an anterior incision with transperitoneal exposure, in forty-four (24.85 per cent). Except in case of very large tumors or questionable renal tumors the posterior lateral incision has been the procedure of choice.

Size, extent of growth, and site of tumor in respect to renal outline apparently have some influence on prognosis. An ar-

bitrary figure was chosen to indicate whether tumors were small, large, or huge. The length of life of patients with tumors designated as huge was considerably less than that of patients in the other groups. This apparently was due to surgical difficulties in extirpation as well as to involvement of adjacent structures. The site of the tumor in relation to the kidney was definitely determined in eighty-nine cases; thirty-eight (42.69 per cent) were in the lower pole; twenty-four (26.96 per cent) in the upper pole; twenty (22.47 per cent) in the median portion, and in seven (7.86 per cent) the whole kidney was involved by tumorous growth. Of the 177 cases in which the growths were extirpated, thirty-two tumors (18.07 per cent) had ruptured through the renal capsule and thirty-nine (22.03 per cent) had extended into the renal pelvis. In thirty-seven (20.90 per cent) the perirenal tissues and adjacent structures such as peritoneum were involved. Whether the tumor involved the upper or the lower pole did not affect the mortality and tumors situated medially appeared to offer only a little better prognosis in terms of longevity. Huge tumors added to the immediate surgical mortality and offered the poorest prognosis from the standpoint of cure. Rupture of the neoplasm through the renal capsule or into the renal pelvis, involvement of the renal vessels, and extension to adjacent structures and the peritoneum lessened greatly the prospects of cure. Of these, extension into the veins was the most serious. This occurred in twenty-three cases (12.99 per cent), with an immediate mortality of five (21.73 per cent) and with a mortality within three years of thirteen (56.52 per cent). However, the amount of involvement of the vessels found at operation and the apparent freedom from metastasis as evidenced by good health for many years following nephrectomy at times is remarkable.

Of the 177 patients on whom nephrectomy was performed eighty-three were given radiotherapy afterward, sixty-six (37.28 per cent) were given roentgen-ray treatment; eleven (6.21 per cent) were given radium, and six (3.38 per cent), a combination of the two. Of twenty-seven patients who were living, twenty-two (81.48 per cent) report themselves as better; two (7.40 per cent) report no change, and three (11.11 per cent)

continue to have weakness or vague complaints. Of those who are living following radiotherapy, four (14.81 per cent) have lived eight years and eight (29.62 per cent) have lived five years. Of the dead, fifty-six (52.83 per cent) received radiotherapy, but the follow-up record is difficult of interpretation for we have no means of determining whether or not adequate radiotherapy was instituted.

The patients on whom exploration only was carried out are considered at this point because of the mortality and the possible value of radiotherapy. As previously stated, all but two are dead: fifteen died within one year, and two died after one year; one lived three and a half years, and one lived four and a half years. Of the dead, nine had radiotherapy. Of the two who are living, both have lived two years and are supposedly in good health. Apparently, in these instances, the growth was too extensive to justify us in anticipating favorable results from radiotherapy, but it was used primarily as palliative treatment. Until accurate check can be made of the efficacy of radiotherapy, it seems advisable empirically to employ it when there is question of incomplete removal of the neoplasm.

Sarcoma.—This type of lesion of the kidney is rare. In our ten cases only eight of the patients were traced. Contrary to the general belief, our statistics do not bear out the assumption that sarcoma occurs chiefly in young adults. Of the eight patients three were men and five were women. Two cases occurred in the third decade, two in the fourth, two in the fifth, and two in the sixth; the average age was forty-seven years. Clinically these cases are of interest because in seven of them there were large palpable masses. The pyelograms were bizarre and it was difficult to distinguish between renal and extrarenal tumors due to the marked displacement and deformity. This in part may be due to the fact that the tumors often originate extrarenally and involve the kidney by direct extension. Anterior incision was made in five instances as a means of surgical approach. This incision was used because of the unusual size of the tumor, and because of the uncertainty whether a renal or an extrarenal condition existed. At operation, all of the tumors were found to be very large; one

weighed 13.75 pounds. The renal vessels were not involved in any of the growths, but there was metastasis to the liver and spleen in one case, and to adjacent structures in two cases. In one case, the tumor definitely originated in the retroperitoneal tissues and involved the kidney secondarily. Histologically, the neoplasms were identified as fibrosarcoma, myxosarcoma, sarcomatous degeneration of lipoma and frank sarcoma. Of the seven patients on whom nephrectomy was performed, two are living, one of them two years and seven months after operation. A recent letter, however, stated that a subsequent operation had been performed and that recovery is doubtful. The other is living after three years and is in perfect health. The growth at operation in this case was 11 cm. long, 9 cm. wide, and 8 cm. thick; and the adjacent lumbar fascia, pleura, and renal pedicle were thought to be involved. The pathologist reported fibrosarcoma. Both of the living patients had roentgen-ray treatment following operation. Of the dead, one lived five years, and died of recurring sarcoma; he had had both roentgen-ray and radium treatment. Two died within one month after operation, and two, both of whom had deep roentgen-ray treatment, within six and ten months respectively. One patient was explored and the mass was found to fill the greater portion of the abdomen. Biopsy resulted in the report of spindle-cell fibrosarcoma. Roentgen-ray treatment was resorted to, although death occurred within a year. Only one of the patients who died had had both roentgen-ray and radiotherapy. From the standpoint of cure following nephrectomy, sarcomas offer the poorest prognosis, apparently due to the fact that the tumor grows rapidly and that involvement of adjacent structures occurs early. It is not possible to evaluate the results of radiotherapy; yet it seems advisable to institute some form of such treatment after operation.

Malignant tumors in children.—Nephrectomy offers a hopeful but not altogether brilliant prospect for the cure of malignant renal tumors in children. There were thirteen cases, in eleven of which the patients were traced and form the basis of this report; three were males and eight females. The youngest was twenty months and the oldest seven years; the average age

was four years. All had palpable tumors; eight were on the right side and three on the left. In three cases exploration was carried out and specimens for biopsy were obtained from two. One of these specimens was reported as sarcoma and the other as carcinoma. Two of the three patients died within five months; the other was reported dead, but no other information was obtained. An anterior incision was used in seven cases, and a combination of anterior and posterior incisions in one. The posterior route of approach was used in two cases, and a transverse route in one. The tumors in all instances were very large. The renal veins were involved in only one case; the perirenal structures were numbered in two cases. The pathologic report lists the tumors as adenocarcinoma, sarcoma, and Wilms' tumors. The nomenclature is not uniform. There is at present an effort to group all malignant renal tumors in children as adenocarcinoma and not as mixed tumors. Of the patients who died, the longest duration of life after operation was thirteen months; the shortest, four months. The average length of life was six and nine-tenths months. Two of those who died had roentgen-ray treatment, and one had treatment with both roentgen ray and radium. Of the patients who are still alive, one has lived seven years, and two months, and is regarded as a healthy, normal child. She had neither postsurgical roentgen-ray nor radium treatment. The other child has lived two years. She has had some radiotherapy. A recent examination showed recurrence of the malignant condition.

There is apparently nothing in this group of statistics that has any bearing on longevity. The value of radiotherapy is questionable, although for lack of absolute knowledge probably it should be applied. These data are in accordance with accepted views. Malignant renal tumors of children offer an extremely poor prognosis; they apparently metastasize long before the original growth is recognized.

Primary squamous-cell epithelioma of the renal pelvis.—This group includes the most interesting of all the renal neoplasms. Their occurrence is relatively infrequent as compared with the solid cortical tumors. Of 271 patients operated on for renal mal-

ignancy twenty-three had squamous-cell epitheliomas; roughly that is equivalent to one in eleven. This is similar to a previous series in which the ratio of squamous-cell epithelioma of the pelvis to solid tumors of the parenchyma was computed to be approximately one to fourteen.

Primary squamous-cell epitheliomas of the urinary tract have a common pathogenesis, whether their site is in the bladder, the ureter, or the pelvis. These tumors are divided into papillary and sessile types, according to their gross appearance. The microscopic characteristics of the cells of primary epithelioma of the renal pelvis readily allow a differential pathologic diagnosis between the sessile and the papillary types. Although the tumors have the same genesis, they differ materially in their degrees of malignancy and the manner of their growth and extension. This is equally true of squamous-cell epithelioma of the bladder. Broders has shown that cellular activity exerts a marked influence on the progress, clinical manifestations, and ultimate results in the treatment of malignant disease. He has utilized cellular differentiation as a means of grading epithelioma, classifying malignancy under four grades, each dependent on the proportion of differentiated to undifferentiated cells. Those graded 1 are least malignant, and those graded 4 most malignant. That there are degrees of malignancy is no longer questionable, and the degree of malignancy must be considered in prognosis.

Primary epitheliomas of the renal pelvis differ in their degrees of malignancy. The papillary epithelioma of the renal pelvis is the least malignant. Of the twenty-three cases of squamous-cell epithelioma of the renal pelvis in our group, thirteen were graded 2; seven were graded 3, and three were graded 4. An analysis of the cases graded 2 revealed one death in the hospital. Twelve patients have been traced subsequently; of these, one has lived nine years; one, eight years, and three have lived an average of one and a half years. Of the eight patients who died, one had lived nine years; one, four years, and one, two and a half years; four patients died within eight months. Of the seven patients with malignant lesions graded 3, three are living; one has been alive four years and three months; two have lived

one year. Of the four who died, one had lived three years and seven months; one, nine months; and two had lived nine weeks and five weeks respectively. Only three patients fell in the group of those whose lesions were graded 4. Of these, two are living; one has lived one year and eight months and the other, eight months. One died after eleven months.

Of the twenty-three cases included in our present group of papillary epithelioma of the renal pelvis, Hunt previously had made a complete analysis of thirteen: the growth in ten was graded 2, in two graded 3, and in one graded 4. Furthermore, he reviewed the end results in a series of eight cases in which the epithelioma of the renal pelvis was sessile; all patients are dead. The results of his analyses are pertinent and are worthy of reiteration. One patient of the eight lived three and a half years and died of metastasis; the remainder lived less than six months. In his cases of papillary epithelioma of the renal pelvis which included thirteen of our present series and two others—that is, fifteen in all—the results were better: six patients were noted to be living and well, three less than a year later, and three for seven, five, and three years respectively. Of the nine who died, one lived seven and a half years; one, four and a half years; one, three and a half years; one, two and a half years; and five less than one year after operation. The degree of malignancy therefore tends to parallel the postoperative length of life. These two types of primary squamous-cell epithelioma of the renal pelvis differ in manner of growth and extension. The sessile epithelioma progresses and extends by invasion into perirenal tissues, renal vein, and so forth, and metastasizes remotely, while the papillary type progresses not by invasion, but by extension along the mucous membrane of the calices, ureter, and bladder.

The tendency of papillary epithelioma of the renal pelvis to progress by extension along the mucous membrane of the ureter, and subsequently into the bladder, has long been recognized. However, unless the bladder is involved, the surgical procedures in the past have been limited usually to nephrectomy, often with partial ureterectomy and occasionally complete ureterectomy; the latter procedure being carried out at a later date, when re-

currence of hematuria indicates ureteral involvement. Four patients in the series of those with papillary epithelioma were treated by simple nephrectomy. One of these with a papillary epithelioma, graded 3, is living and well three years after operation. One patient with an epithelioma graded 2 died after four years with extensive recurrence in the bladder; two patients with epithelioma graded 2 died at the end of five and six months, respectively. One patient with a papillary epithelioma graded 2 is living and well seven years after nephrectomy and partial ureterectomy. In eight cases complete nephro-ureterectomy was performed; the ureterectomy was done from two weeks to as late as twenty-one months after nephrectomy. In four of these it was necessary to perform simultaneous segmental resection of the bladder for vesical metastasis that had occurred since the nephrectomy. There were two deaths in hospital in this entire series of papillary cases, one from pulmonary embolism on the eleventh day, and the other from pelvic peritonitis on the thirteenth day. The peritonitis resulted from a necessary transperitoneal resection of the bladder. One patient of this group was living and was free from recurrence at a recent examination, five and a half years after operation; another is living four months after operation. Three patients who died from recurrence lived, respectively, two and a half, three and a half, and seven and a half years, following late ureterectomy and resection of the bladder for metastasis.

True papillary epithelioma early in its development may remain confined to the renal pelvis and may involve the major portion of the renal pelvis and calices before it extends down the ureter; or, as in one case, the primary lesion may remain small with early progression and extensive involvement of the ureter and bladder, occlusion of the ureter, and early hydronephrosis. In none of the eight cases of sessile epithelioma of the renal pelvis was the bladder involved, nor was the ureter or bladder affected at any time previous to death. Of the group of fifteen cases of papillary epithelioma of the renal pelvis, the bladder around the ureteral orifice or immediately adjacent to it was involved in four; in five others involvement of the bladder was noted from

nine to fourteen months after nephrectomy. From information received, it may be assumed that the hematuria which occurred in the latter months of life in two other cases was due to recurrence.

With the exception of the one patient living three years after nephrectomy for a papillary epithelioma graded 3, and of the two patients with tumors graded 3 and 4 who died in the hospital, all the patients in this series had had tumors graded 2. The grade of malignancy being equal, it is obvious that ureterectomy in addition to nephrectomy, even though a number of months later, offers a better prognosis than is offered by nephrectomy.

We would emphasize that as far as malignant tumors of the kidney are concerned papillary epithelioma of the renal pelvis is the least malignant. It tends to progress by extension along the mucous membrane of the pelvis, ureters, and bladder. Even though the grade of malignancy remains the same as that of the primary lesion, the prognosis is materially altered when extension to the bladder has occurred. In order to forestall such metastasis, segmental resection of the bladder should be performed simultaneously with complete nephro-ureterectomy.

URINARY TUBERCULOSIS

HERMON C. BUMPUS, JR.

REPORT OF A CASE

A man aged nineteen years entered The Mayo Clinic, October 22, 1928, complaining of burning on urination. Three months previously he had noticed increasing frequency and dysuria. After a few weeks pyuria and hematuria were noted and nocturia became severe. He was treated by irrigations of the bladder with mercurochrome.

General examination was negative. Renal function and the urea content of the blood were normal. Urinalysis showed large amounts of pus and an occasional red blood cell. A stained specimen of the sediment was positive for bacilli of tuberculosis. Roentgenograms of the urinary tract showed multiple small shadows in the region of the right kidney. Roentgenograms of the chest were negative. Cystoscopic examination, which was more painful than usual, revealed areal cystitis. Obstruction was met in an attempt to pass a catheter up the right ureter, while a catheter passed up the left side without difficulty and clear urine was obtained from the left kidney. A diagnosis of right renal tuberculosis was made and right nephrectomy performed October 26. Pathologic examination of the kidney showed marked tuberculous ulceration of the renal pelvis, with areas of calcification and destruction of about 30 per cent of the kidney.

This case is instructive from the many standpoints from which the correct diagnosis might be made. When patients in early adult life complain of symptoms of cystitis the possibility of urinary tuberculosis should at once enter the physician's mind. If the patient is a male, careful inspection of the genitalia should be made for coexisting genital tuberculosis. This is manifested by thickening of the epididymis, a nodular prostate, or scarring

of the vesicle. In 72 per cent of a series of cases with both genital and urinary tuberculosis, renal tuberculosis was found on the same side as the affected epididymis.

In this particular case such examination was made, but definite evidence of genital tuberculosis did not exist. Such evidence is, of course, usually confirmatory, as genital tuberculosis may exist without coincident urinary tuberculosis. When suggestive evidence in the genital tract is found, or in other parts of the body, such as the lungs, the urine is stained for bacilli of tuberculosis. As in this case, the organism will be found if carefully searched for in the urinary sediment in more than 90 per cent of cases. There is little doubt that if urinary sediments were as frequently stained for bacilli of tuberculosis in cases of cystitis as is the sputum in cases of chronic cough, the diagnosis of urinary tuberculosis would often be made during its incipiency.

After the organisms were found in this case, it remained to determine which kidney was involved, for it is not until the terminal stages of the disease that the condition becomes bilateral. Careful examination of the roentgenograms of the urinary tract showed multiple points of calcification in the right renal area. These immediately pointed to the right kidney as the one probably infected. In fact, the finding of such calcified areas, together with bacilli of tuberculosis in the urine, is almost positive proof of renal involvement. Cystoscopic examination was, however, imperative in order to ascertain that the left kidney had sufficient function to carry on life after removal of the right, as the percentage of unilateral or atrophic kidneys is sufficiently high to make it unsafe to perform nephrectomy without this precaution.

On cystoscopic examination the extreme irritability of the patient at once suggests tuberculous involvement, especially in a young person, and the fact that the cystitis is areal rather than general, further suggests it, for as the infected material enters the bladder, individual tuberculous ulcerations form which later coalesce and form large areas of ulceration with definite sloughing. If the process continues untreated, scarring and further ulceration occur until the entire bladder becomes cica-

trized, including the sphincters, and is reduced to a capacity of only 30 or 60 c.c., and complete incontinence results from nonfunction of the sphincter. As this case has been of only three months' duration, such an extensive ulceration would not have had time to develop. When an attempt was made to catheterize the right ureter, obstruction was met a few centimeters from the bladder, still another diagnostic point strongly suggestive of tuberculosis.

FIG. 65.—Tuberculosis of the right kidney.

Stricture of the ureter sometimes occurs with urinary tuberculosis, which completely occludes the ureter, after which the kidney becomes functionless, no more infected urine enters the bladder, the tuberculous cystitis heals, and apparent cure of the disease takes place. This is sometimes referred to as autonephrectomy, the kidney being treated as a sclerotic and calcified foreign body. Some of the successfully reported medical cures of renal tuberculosis are undoubtedly of this type. The

left kidney was catheterized and since obstruction was not met and since clear urine was obtained, the diagnosis was complete.

It will be noted that cystoscopic examination in this case did not include a pyelogram. This is seldom necessary and is frequently fraught with considerable danger. As recent work has shown, the pelvic contents frequently enter the blood stream when the intrapelvic pressure is only slightly raised, and the dan-

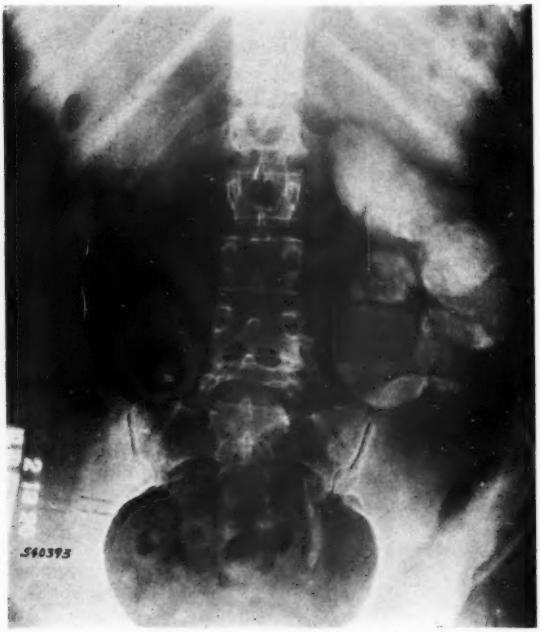


FIG. 66.—Large calcified tuberculous lesion of the left kidney.

gers of producing miliary tuberculosis from urography must not be overlooked. When the diagnosis is possible without it, urography should not be resorted to as a confirmatory measure (Fig. 65 and 66).

If the diagnosis is not possible without urography, the injection of 12 per cent sodium iodid solution will usually show characteristic irregularities in the minor calices, even in the earlier

cases. These are sometimes referred to as being moth-eaten in appearance, and are due to the fact that the tubercles which have formed in these areas, usually in the upper and lower pole, have destroyed the papillæ and discharged caseous material directly into the renal pelvis. In cases of long duration this process often includes all of the calices so that the normal contour of the pelvis is completely destroyed and the medium extravasates into the cortical portions of the kidney. The outline of a markedly dilated and tortuous ureter is also characteristic of the disease if it is of long standing.

It should be noted that in urinary tuberculosis there are five diagnostic points, almost any combination of which will make the diagnosis possible without resort to urography: (1) The presence of the bacilli of tuberculosis in the urine; (2) characteristic, extremely painful cystitis; (3) calcified areas in the region of the kidney; (4) frequency of stricture in the involved ureter, and (5) coexisting genital tuberculosis.

OBSTRUCTION OF THE UPPER PORTION OF THE URINARY TRACT

WALTMAN WALTERS

W. J. MAYO's early clinical observation on the effect of obstruction to transmission of urine from the kidney into the bladder has for many years substantiated itself in the treatment of obstruction of the upper portion of the urinary tract. He observed that in most instances in which obstruction occurred in half of the urinary tract sufficient to produce partial atrophy and reduction in function of the kidney on that side, and in which corresponding hypertrophy and hyperfunction occurred in the unobstructed kidney, progressive atrophy of the obstructed kidney often continued even though the obstruction was removed. Experimental confirmation of this clinical observation is noted in the work of Hinman and Butler on hydronephrosis. After they had produced hydronephrosis experimentally in animals by obstructing one or the other of the ureters and relieving the obstruction after periods varying from seven to twenty-eight days, they found that if the obstruction had existed for longer than fourteen days and was then relieved, and if the obstructed kidney was left in partnership with a normal kidney which meanwhile had undergone compensatory hypertrophy, disuse atrophy of the kidney whose outflow of urine had been obstructed would replace the initial repair; if the normal kidney was removed, however, atrophy would cease and hypertrophy would occur.

INFECTION

It should be added from the clinical standpoint that in many instances the determining factor as regards prognosis of renal function following the removal of factors producing incomplete obstruction to the passage of its urine is dependent to a con-

History.—October 17, 1927, a woman aged forty-two years was examined with complaint of:

Pain in the left lumbar region for eight years.

Slight dysuria.

Intermittent left renal colic.

General examination.—Roentgenograms showed stone in the lower part of the left ureter.

Cystoscopic examination showed impacted, wedge-shaped calculus at the ureterovesical juncture on the left side.

The right kidney was normal.

Differential functional tests of the kidneys showed a return of 10 per cent phenolsulphonephthalein from the right kidney, none from the left kidney, and 5 per cent from the bladder.

Elimination of indigocarmin was graded 4 from the right kidney and 1 from the left kidney.

Operation.—October 25, left ureterolithotomy was performed November 16. The indigocarmin return from the right ureter was graded 4, and from the left 4.

Fifteen cubic centimeters of fluid was obtained from the dilated left renal pelvis.

Postoperative course.—July 10, 1928, the patient returned for the repair of a small postoperative hernia.

Slight dysuria was present.

The phenolsulphonephthalein return from the right kidney was 10 per cent, from the left 2 per cent, and from the bladder 15 per cent.

Specimens from the right ureter showed absence of pus, and of erythrocytes.

Specimens from the left ureter showed pus, graded 1 (10 cells), and absence of erythrocytes.

Chronic diffuse cystitis was present.

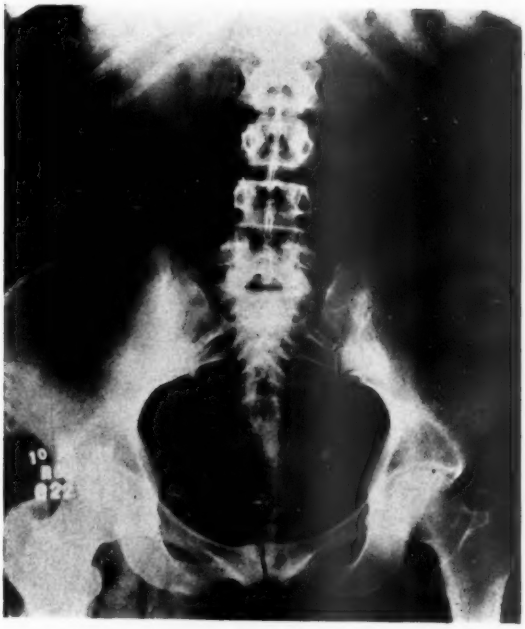


FIG. 67.

siderable extent on the degree of infection which exists in the obstructed kidney. Hunt in large segmental resections of the bladder has noted that ligation of a ureter from a noninfected kidney is followed by symptomless atrophy of the kidney; if renal infection is present, secondary nephrectomy becomes necessary. When the obstructing factor is a stone or stones, irritation often gives evidence of infection more severe than really exists in that portion of the urinary tract. It is not uncommon after the removal of such stones, whether from the renal pelvis or the ureter, to find that the evidence of infection disappears and differential tests of renal function are satisfactory. An example of this is a case in which, according to the history, ureteral calculus had probably been present producing incomplete urinary obstruction for four or possibly eight years. October 25, 1927, I removed the stone from the ureter. A month afterward, on cystoscopic examination the elimination of indigocarmin from both kidneys was graded 4 (Fig. 67). July 17, 1928, when the patient returned for the repair of a small incisional hernia, cystoscopic examination showed the function of both kidneys to be satisfactory.

ACUTE OBSTRUCTION

When acute and complete obstruction of the ureter occurs, acute pyelonephritis and cortical abscesses also occur if the kidney is infected. Recently right nephrectomy was performed as an emergency procedure in a case in which complete obstruction of the right half of the urinary tract had existed for approximately forty-eight hours. The obstruction was presumably due to a stone which had migrated from the renal pelvis into the ureter. The patient, who had been having repeated chills and fever, and who had been moribund with impending circulatory failure prior to operation, was able to sit up in a chair ten days later. Nephrectomy was performed under local anesthesia in the patient's room. Two forceps were left on the renal pedicle, and the wound left open for drainage (Fig. 68). Pathologically, the removed kidney showed multiple cortical abscesses and acute pyelonephritis.

Similar acute and complete obstruction of the right ureter occurred in another case, July 1, 1928. The patient appeared at the Clinic two days after an attack of lumbar colic on the right side, radiating into the symphysis pubis. Cystoscopic examination revealed a spurting blood vessel in the right ureteral orifice; an impassable obstruction to the ureteral catheter was encountered in the right ureter directly above the bladder. A ureteral calculus seemed a possibility and yet the roentgenogram of the kidneys, ureters, and bladder did not reveal abnormal shadows. Only slight fever was present in contrast to the preceding case in which the renal infection played such an important part (Fig. 69). Marked abdominal tenderness and induration along the course of the right ureter delayed operation for two days, during which time the blood urea rose from 176, July 9, to 222, July 11. At this time it seemed essential to establish external drainage of the right half of the urinary tract. Nephrostomy or pelviostomy was thought to be the best operation in view of the fact that the differential function of the left kidney was uncertain, as it had been on examination in August, 1921 when a differential test showed excretion of 2 per cent of phenolsulphonephthalein from the left kidney and 18 per cent from the right. July 11 right nephrostomy with drainage was performed; the kidney was hugely enlarged from hypertrophy as well as from urinary obstruction. The periureteral space was drained of a considerable amount of fluid. The patient's convalescence was excellent. Urine continued to drain from the nephrostomy wound, and July 20 the blood urea had dropped to 60 mg. July 30 the incision was completely healed, the blood urea normal, and the patient able to return home. The general condition was good. Further conduct of this case is dependent on the nature of the obstruction of the lower part of the right ureter. The case shows that urea can accumulate in the blood to a considerable degree in the presence of obstruction to one kidney. It should be borne in mind, however, that, in view of the questionable function of the left kidney, the right kidney with its hypertrophy may be carrying on most of the renal function.

History.—A man aged fifty-nine years reported an intermittent dull ache in the right side of ten years' duration, and right renal colic; pain had radiated to the region of the bladder twelve days before admission.

The patient was sent to hospital on arrival.

Examination.—June 25, 1928 a shadow was noted in the right renal area.

Pyelogram showed dilatation of pelvis, graded 2, and of calices, graded 1, and shadow in the lower calix.

The left kidney was apparently normal.

Specimens from the right ureter showed pus, graded 1 (20 cells), and erythrocytes, graded 3.

Differential functional tests of the kidneys showed a return of 2 per cent phenolsulphonephthalein from the right kidney, none from the left kidney, and 15 per cent from the bladder.

Elimination of indigocarmine was graded 1 from the right kidney and 4 from the left kidney.

Preoperative course.—June 27 the patient had chills and fever.

Two catheters were inserted into the right ureter for drainage.

June 28 the catheters were draining poorly.

Chills and fever continued with severe right renal colic.

The pulse was fast and weak.

The patient was delirious.

The extremities were cold.

Operation.—June 28, right nephrectomy was performed under local anesthesia in the patient's room.

Multiple cortical abscesses with acute pyelonephritis were found.

Postoperative course.—June 29, a blood transfusion was done.

July 17, the patient was dismissed from hospital.

His general condition was good.

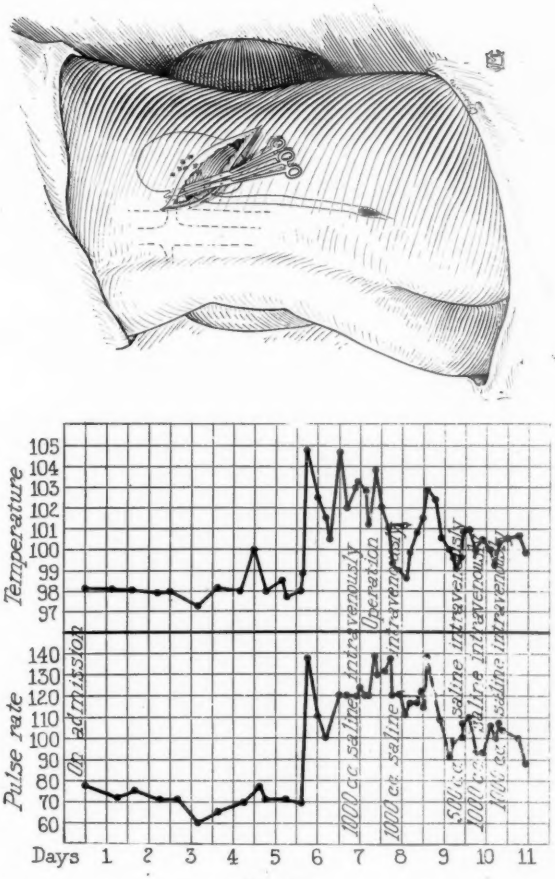

Temperature
105
104
103
102
101
100
99
98
97
Pulse rate
140
130
120
110
100
90
80
70
60
Days 1 2 3 4 5 6 7 8 9 10 11
On admission
1000 cc. saline intravenously
Operation
1000 cc. saline intravenously
500 cc. saline intravenously
1000 cc. saline intravenously
500 cc. saline intravenously

FIG. 68.

History.—July 3, 1928, a man aged fifty-one years entered the Clinic with an intermittent pain in the right lumbar and right abdominal regions of four months' duration.

Two days previously there was pain in the right side of the abdomen and in the back.

The urine was bloody.

August 11, 1921, at a cystoscopic examination the condition of the left kidney was found to be indeterminate.

The differential functional tests of the kidneys at this time showed a return of 18 per cent phenolsulphonephthalein from the right kidney, and 2 per cent from the left.

Erythrocytes were graded 1 on the right and also on the left.

Pus was graded 1 on the right and also on the left.

Examination.—July 4, 1928, roentgenologic examination of the kidneys, ureter, and bladder was negative.

July 5, a cystoscopic examination showed a spurting blood vessel. in the right ureteral orifice and a stone (?) in the lower right ureter.

Gross blood was not found in the urine when the patient was examined in hospital.

The quantity of the urine was 1,400 c.c.

July 9, the blood urea was 176 and the creatinin 6.8.

Leukocytes numbered 18,000.

July 11, the blood urea was 222 and the creatinin 8.0.

There was induration and tenderness along the course of the right ureter.

Fever was not present.

Operation.—July 11, right nephrostomy was performed and the retroperitoneal space was drained.

A huge hydronephrotic kidney with perirenal and periureteral extravasation of fluid was discovered at operation.

Postoperative course.—July 13, the blood urea was 123 and the creatinin 2.4

July 20, the blood urea was 60.

July 24, the general condition of the patient was excellent and all drains were removed.

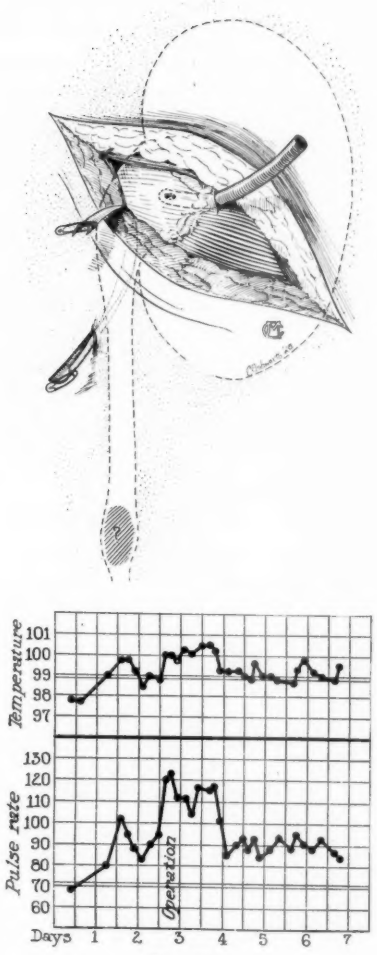

Temperature
101
100
99
98
97
Pulse rate
130
120
110
100
90
80
70
60
Operation
Days 1 2 3 4 5 6 7

FIG. 69.

RESECTION OF THE RENAL PELVIS WITH REIMPLANTATION OF URETER FOR HYDRONEPHROSIS

Isolated cases in which plastic operations have been performed for the relief of obstruction at the ureteropelvic juncture producing small degrees of hydronephrosis can be found in the literature. Several such cases have been reported from the Clinic by C. H. Mayo and Judd. The obstruction has been frequently due to an anomalous renal artery crossing the ureter at the pelvic juncture, and the division of this artery in cases in which the hydronephrosis has been slight with little infection in the pelvis of the kidney has given good results in many instances. At least it is worthy of trial even though secondary nephrectomy becomes necessary later in a few cases. Spasm at the ureteroplevic juncture, the result of faulty neuromuscular control, has been advanced as a cause of the obstruction in those cases in which hydronephrosis exists and in which anatomic evidence of obstruction cannot be demonstrated. Quinby reported a group of thirteen cases of hydronephrosis in seven of which plastic procedures had been performed consisting of resection of the renal pelvis in two cases, and reimplantation of the ureter into the side of the pelvis at its dependent portion in five. His results in these cases as measured by relief of pain and freedom from symptoms seemed very good. Presumably a report of the differential renal function and urographic studies following operation will soon be forthcoming, such being necessary in order to be sure that atrophy has not taken place in the kidney on which plastic operation was performed.

Recently I was able to resect the left renal pelvis in a case of hydronephrosis without infection, and with good function in the kidney (Fig. 70). The patient, a woman aged twenty-five, had had symptoms of renal colic for only three months, although the symptoms had been severe and required morphin for relief. The kidney appeared to be in such good condition by tests of function and appearance at the time of operation that it seemed worth while to attempt a plastic procedure on the pelvis and ureter in the hope of saving the kidney and relieving symptoms.

Neither an anomalous blood vessel nor any demonstrable cause for the hydronephrosis was present. The ureteropelvic juncture appeared normal; its opening was in the dependent portion of the pelvis and there seemed to be no reason why the renal pelvis should not empty satisfactorily. The ureter was severed from the pelvis, the latter resected to within 1 cm. of the renal substance, and the opening closed to a sufficient size to allow reimplantation of the ureter into its almost dependent portion, the anastomosis used being similar to that of gastro-enterostomy. The operation was performed July 5. The postoperative convalescence for eleven days was uneventful, without fever or pain. There was urinary drainage from the wound until July 16 when, with cessation of drainage, chills and fever occurred for three days presumably as a result of disturbance of motility at the point of the anastomosis of the ureter to the pelvis. On cystoscopic examination July 19 urine was found to be draining from the left ureter, although 5 c.c. of turbid fluid was withdrawn from the renal pelvis. A No. 10 bulb was passed through the anastomosis into the pelvis of the kidney. The subsequent course was very satisfactory; there has not been further fever or chills and drainage from the wound has ceased. August 14 a differential functional test showed an excretion of 15 per cent phenolsulphonephthalein from the left kidney, and 20 per cent from the right in fifteen minutes, with 2 per cent in the bladder. Ureteral urinary specimens showed urine from the left kidney to contain pus, graded 1, and urine from the right kidney to be normal. A pyelogram of the left kidney showed a normal-sized pelvis with dilatation of calices, graded 1 (Fig. 71).

I have since performed two other plastic operations on the pelvis and ureter for the relief of hydronephrosis. In one case I performed ureteropelviostomy for the relief of complete ureteropelvic obstruction producing hydronephrosis in a patient with a solitary kidney. In the other case I performed resection of the renal pelvis for hydronephrosis. These two patients, as in the case described in detail, recovered uneventfully.

History.—June 28, 1928, a woman aged twenty-five years registered.
For three months previously she had had intermittent left renal colic, requiring morphin.

Examination.—June 30, elimination of indigocarmin was graded 4 in the right kidney and 4 in the left kidney.
Pus was not present.
Erythrocytes were graded 1 in the right kidney, but none was found in urine from the left kidney.
Left hydronephrosis was diagnosed.
There was absence of infection and function was good.

Operation.—July 5, resection of the extrarenal pelvis of the left kidney and reimplantation of the ureter were performed.

Postoperative course.—From July 16 to July 19 fever was present and the wound was dry.
July 19, the left ureteropelvic juncture was dilated.
Five cubic centimeters of turbid fluid (pus graded 4) was removed.
From July 19 to July 23 there was no fever.
During this time there was slight drainage of urine from the wound.
July 28, wound healed; general condition excellent.

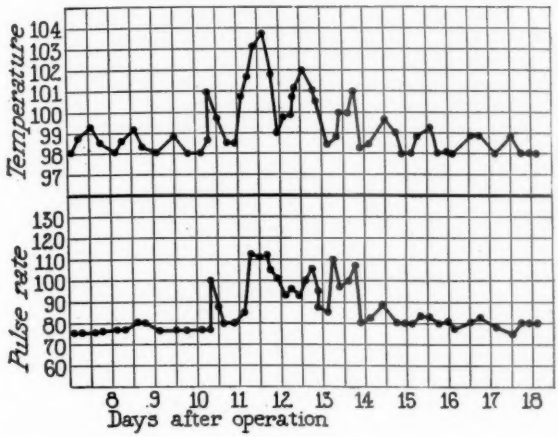

Temperature
104
103
102
101
100
99
98
97
Pulse rate
130
120
110
100
90
80
70
60
8 9 10 11 12 13 14 15 16 17 18
Days after operation

FIG. 70.

Examination.—June 30, 1928, ureteral specimens from a woman aged twenty-four years, showed erythrocytes graded 1 in the right kidney.

Erythrocytes were not present in the left kidney.

Pus was not present in either the right or left kidney.

Operation.—July 5, the extrarenal pelvis was resected from the left kidney, with reimplantation of the ureter for hydronephrosis.

Postoperative course.—August 14, differential functional tests of the kidneys showed a return of 20 per cent phenolsulphonephthalein from the right kidney, 15 per cent from the left kidney, and 2 per cent from the bladder.

The specific gravity of urine from the right kidney was 1.019 and from the left 1.015.

Ureteral specimens showed erythrocytes, graded 3, in the right kidney, and pus was not present.

Pus was graded 3 in the left kidney and the erythrocytes were graded 1.

Pelvic lavage was carried out.

August 20, the pus was graded 1 in the left kidney and erythrocytes were not present.

The general condition was excellent and the wound had healed.

September 14, pus or erythrocytes were not present in either kidney.

There was no urinary disturbance.

September 14, the patient was dismissed from observation.

The general condition was excellent.

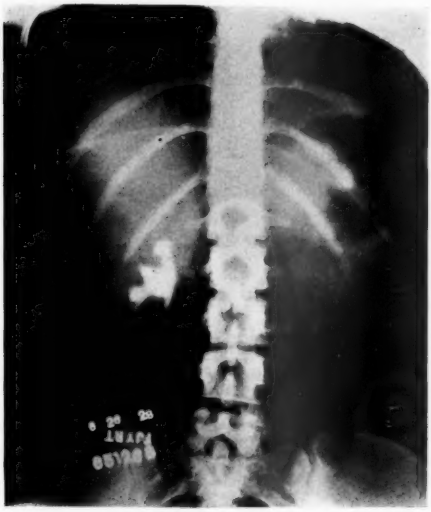
FIG. 71.

History.—June 22, 1928, a woman aged twenty-nine years was examined.
She reported dysuria with fever.
Two years previously she had had left renal colic with the passing of a stone.
Frequency and burning had continued after this.

Examination.—A large branched stone completely filling the pelvis and the calices of the right kidney was found at cystoscopic examination.
There was moderate infection.
The left kidney was normal.
Differential functional tests of the kidneys showed a return of 10 per cent phenolsulphonephthalein from the right kidney and 15 per cent from the left.
Ureteral specimens showed pus, graded 2, in the right kidney.
Pus was not present in the left kidney.
Erythrocytes in the right kidney were graded 1+ and in the left kidney were graded 3.

Operation.—July 3, right pelviolithotomy was performed.
The stone was removed entirely with the exception of a round, ball-like projection in the upper calix which was removed separately.
One split tube drain was inserted in the renal pelvis and three Penrose cigarette drains were used.

Postoperative course.—The split tube was removed from the pelvis on the sixth postoperative day.
There was no drainage on the tenth postoperative day.
July 20, the wound was healed.
The general condition was excellent.
A roentgenogram of the right renal area was negative.



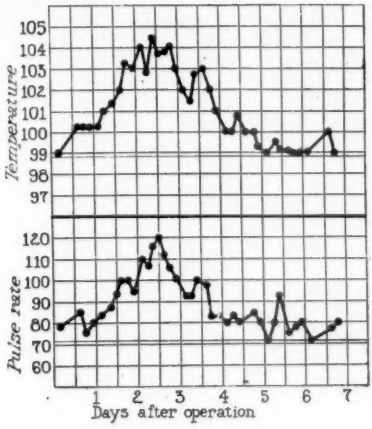
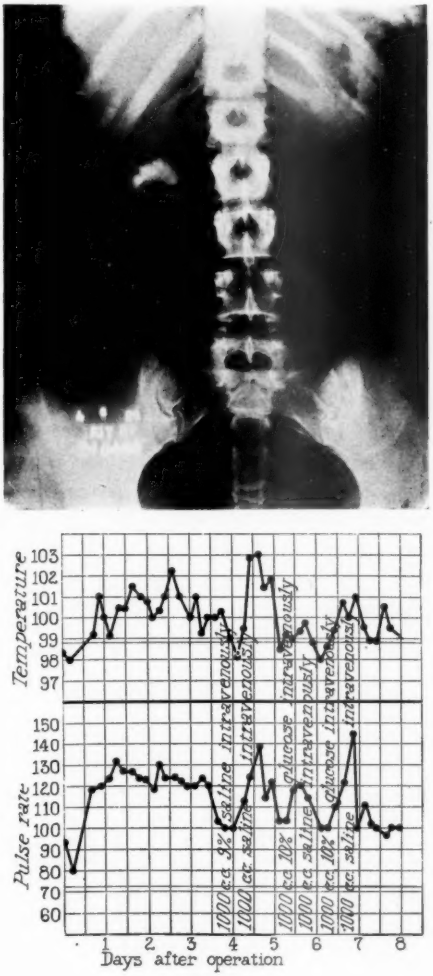

Temperature
105
104
103
102
101
100
99
98
97
Pulse rate
120
110
100
90
80
70
60
1 2 3 4 5 6 7
Days after operation

FIG. 72.

History.—April 2, 1928, a woman aged twenty-six years was examined.
She had had right renal colics for nine months.
General examination.—Pus and blood were found in the urine.
Cystoscopic examination disclosed a large branched stone in the right kidney.
There was considerable infection in the right kidney and the function was greatly reduced.
The function of the left kidney was good.
At consultation the function of the right kidney was believed better than the dye tests indicated.
Pelviolithotomy or nephrectomy was recommended providing the kidney warranted it.
First operation.—April 7, right pelviolithotomy was performed.
A large stone was removed.
A catheter was introduced through the cortex into the ureter.
Postoperative course.—Irregular fever was present.
There was a palpable tender mass in the right renal area.
Constant gastric retention for fourteen days varied from 225 c.c. each day to 4,220 c.c.
The blood urea, carbon dioxid, and chlorids were normal.
Second operation.—April 21, right nephrectomy was performed.
There was septic pyelonephritis on chronic pyelonephritis.
Perirenal infection was present.
The forceps were left on.
The wound in the renal pedicle was left open.
Postoperative course.—May 25, the wound was healed.
The general condition was excellent and the patient was dismissed.


Temperature
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Pulse rate
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110
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80
70
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1000 c.c. 3% saline intravenously
1000 c.c. saline intravenously
1000 c.c. 10% glucose intravenously
1000 c.c. saline intravenously
1000 c.c. 10% glucose intravenously
1000 c.c. saline intravenously
1 2 3 4 5 6 7 8
Days after operation

FIG. 73.

LARGE STONES IN THE PELVIS OF THE KIDNEY AND CALICES

Not infrequently large stones may completely fill the pelvis and produce sufficient intermittent obstruction to cause renal colic, fever, and dysuria. When the function of the kidney containing the stone is good, even though a moderate amount of infection exists in it, the conservative operation of pelviolithotomy can, in most cases, be satisfactorily accomplished as measured by the complete removal of the entire stone, and its fragments as well as the satisfactory convalescence from the operation. It is surprising how easily many such large stones can be removed intact through a moderate-sized incision in the pelvis of the kidney. In one case a branched stone completely filling the pelvis and calices was removed intact with the exception of the rounded ball-like projection filling the upper calix, which was removed separately. The operation was followed by an uneventful convalescence (Fig. 72). Following removal of a large stone of the branched type, especially in the presence of infection in the kidney, it is necessary to drain the pelvis of the kidney. By this procedure the closed cavity of the renal pelvis is converted, for the time being, into an open cavity, efficiently drained. The tube may be inserted either through an incision in the pelvis or through an opening made in the cortex, and may be removed on the sixth or seventh day without fear of a persistent urinary sinus. The advantage is clearly indicated in such a case. If the infection which occurred, probably as a result of the manipulation of the kidney for removal of the stone, had been confined to the pelvis, pyelonephritis or pyelonephrosis sufficiently severe to necessitate secondary nephrectomy might have followed. An example of this is the following: A young woman had had renal colics for nine months, and pus and blood were present in the urine; there was infection of the kidney and marked reduction in function. It seemed, however, that the stone might be preventing the excretion of dye and that the infection might not be as severe as it seemed. Pelviolithotomy was performed, but the pelvis was not drained and, through an oversight in closing the wound, an opening large enough to allow drainage from around the kidney to the exterior was not made. Consequently there was irregular

fever, and a tender mass could be palpated in the right renal area (the enlarged infected kidney). Constant gastric retention of from 225 to 4,220 c.c. persisted for fourteen days, when secondary nephrectomy was performed, and septic pyelonephritis on chronic pyelonephritis was found, as well as much infection around the kidney. Forceps were left on the renal pedicle and the wound was left open for better drainage. Convalescence from the second operation has been satisfactory; the wound has healed by secondary intention, and the patient is ready to return home (Fig. 73).

LEFT PYONEPHROSIS WITH DOUBLE URETER AND NEOPLASM IN THE RIGHT WALL OF THE BLADDER

The following case of pyonephrosis on the left side is presented because of its association with neoplasm of the bladder involving the right wall of the bladder and base. The exact cause of obstruction was not demonstrable. Apparently the renal pelvis was reduplicated for there were two ureters leading from the kidney, the lower one dilated to such size that it resembled a loop of small intestine; the upper ureter was normal in size. The infected hydronephrotic sac was removed April 25. Convalescence was uneventful and on June 6 the patient's condition had improved so much that segmental resection of the right wall of the bladder was performed, removing the growth and normal wall for 1.5 cm. beyond the periphery of the growth. The carcinoma was approximately 7.5 cm. in diameter and extended down to within 1 cm. of the right ureterovesical orifice. In the segmental resection of the bladder containing the growth the transvesical portion of the ureter was exposed. A catheter was inserted into it to be sure that its continuity was not disturbed, and the bladder reconstructed around the right ureter and its orifice. Convalescence was excellent (Fig. 74). A moderate amount of urinary obstruction from an enlarged prostate has retarded the healing of the suprapubic wound and on one or two occasions there has been irregular fever for a few days, suggestive of mild pyelonephritis in the remaining kidney.

History.—April 12, 1928, a man aged sixty-five years was examined.
The patient had had bloody urine of one year's duration.
He experienced difficulty in starting urine.
April 8 there had been acute urinary retention.
He had lost 8 pounds in weight.

General examination.—Hypertrophy of the prostate, graded 2, was noted.
Leukocytes numbered 12,800.
The erythrocytes in the urine were graded 4, the pus 2.
The phenolsulphonephthalein return was 35 per cent.
The blood urea was 42 mg.
Cystoscopic examination revealed a neoplasm in the right wall and in the dome of the bladder, and left pyonephrosis.

Operation.—April 25, left nephrectomy for infected hydronephrotic sac was performed.
There was almost complete destruction of the kidney substance.
Double ureter was noted.
The kidney weighed 200 gm.
June 6, segmental resection of the posterior and lateral wall of the bladder on the right side was performed for papillary, squamous-cell epithelioma, graded 4, involving perivesical fat and the bladder wall.

Postoperative course.—July 25, the patient was dismissed from observation.
The general condition was good.

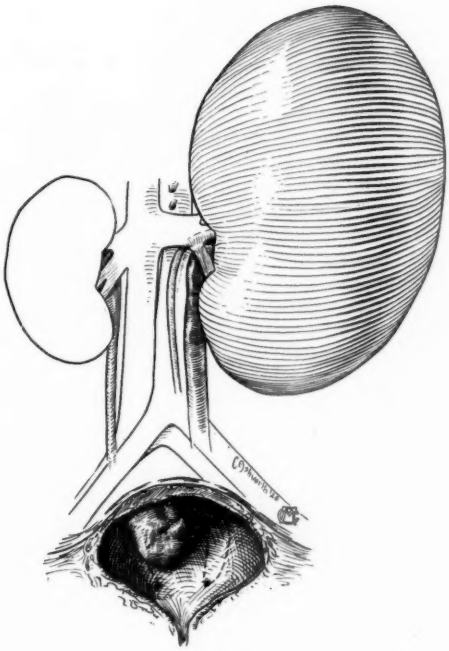

FIG. 74.

NONPARASITIC CYSTS OF THE LIVER

HAROLD D. CAYLOR

THE pathologic and pertinent clinical data in twenty-four cases of nonparasitic cysts of the liver in which all or a portion of the cyst or cysts was removed in the course of an abdominal operation were reviewed. Cysts of the round ligament of the liver as described by Henderson were not included. The symptoms of twelve of the patients were apparently caused by the presence of cysts in the liver.

LITERATURE

Kaufmann divided nonparasitic cysts of the liver into two large groups: retention cysts, and polycystic liver (hepar cysticum). He subdivided the first group into simple cysts and multilocular cysts. He believed that retention cysts of the liver are probably caused by obstruction of preëxisting or newly developed intrahepatic bile ducts. Castelli described multiple cysts in the center of the liver associated with a cavernous hemangioma. So-called lymph cysts have also been noted. The most common are small simple cysts under the capsule of the liver filled with mucus, clear, serous, or watery fluid, or bile. The lining of these cysts, according to Kaufmann, is simple, flat, cuboidal, columnar, or ciliated epithelium. This type of cyst is usually only a few centimeters in diameter and is commonly an accidental finding in the course of an abdominal operation. Simple cysts of the liver may also be found in cirrhosis of the liver. Ewing quoted Rolleston who observed many subserous cysts containing inspissated bile. Furthermore, Ewing noted that in cirrhosis of the liver with nodular hyperplasia or adenomas, the hypertrophic nodule may break down and yield small cysts of the parenchyma. Multilocular cysts are usually lined as are the simple cysts, and

their walls may have prominent trabeculations which probably are a result of confluence of several smaller cysts. The content varies as in simple cysts. Kaufmann believed that cysts in the second large group, polycystic liver, are probably caused by a defect in embryonal development of the biliary passages. The disorder is sometimes congenital, but it is found most frequently in older persons. It is often associated with polycystic kidneys, but the reverse is not true. The cysts are usually filled with clear watery fluid and the walls are lined by columnar to flat cells. The liver may attain a weight of 10 kg. Icterus and other signs of disturbed function are usually absent, but ascites, splenic enlargement, or gastro-intestinal disorders may be present. Ewing believed that there is a neoplastic element in this disorder (polycystic liver) which may be an adenomatous change.

Jones outlined eight divisions of nonparasitic cysts of the liver as follows: (1) Teratomas or embryomas; (2) pseudocysts; (3) lymphatic cysts; (4) cystic degeneration of liver with cystic kidneys; (5) cysts that arise from blood vessels; (6) cystadenoma from bile ducts; (7) ciliated epithelial cysts, and (8) retention cysts.

CYSTS ASSOCIATED WITH SYMPTOMS

In twelve of the twenty-four cases in my series the patients had symptoms which were apparently caused by the presence of the cyst or cysts. Four of these patients had polycystic disease of the liver. Of the remaining eight patients, six had multilocular cysts and two simple cysts.

Polycystic disease of the liver.—In the group of polycystic disease of the liver there were three women and one man. The average age of these four patients at the time of operation was forty-seven and two-tenths years; the youngest was thirty and the oldest seventy. The length of time that symptoms had been present varied from four months to several years. All four patients with polycystic disease had pain in the abdomen which varied from dull vague abdominal discomfort to severe cramps. Two patients complained of distress in the right upper quadrant of the abdomen, and one complained chiefly of epigastric distress. This patient noticed an abdominal tumor after an attack

of severe cramping epigastric pain. In three of the cases the pain came on suddenly, was usually cramp-like and one patient complained of residual soreness. Three of the four patients had a tender abdominal tumor at the time of the first examination. The patient having the shortest history (four months) had lost 8 pounds (3.6 kg.) in weight in two months. In two cases polycystic disease of the liver was associated with polycystic kidneys. One of these was a man aged seventy; appendectomy had been performed at the age of fifty-five. The liver was found to be en-

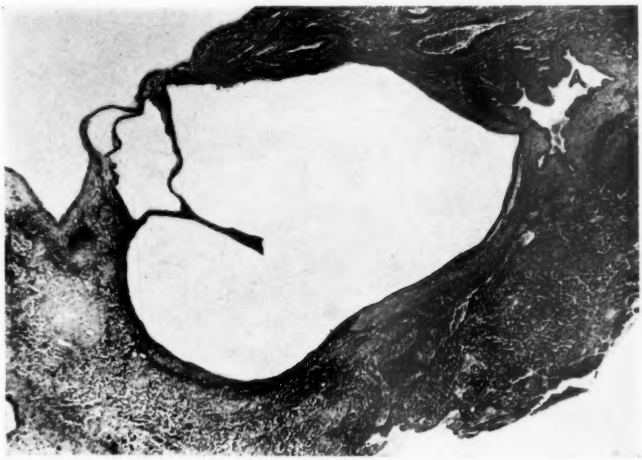

FIG. 75.—Polycystic disease of the liver. Areas of lymphocytic infiltration, varying degrees of destruction of hepatic cells, and thin-walled cysts are shown. There is a dilated bile duct at *A* (×30).

larged with cysts which were thought to be due to echinococci. Fifteen years later on exploration at The Mayo Clinic echinococcic hooklets were not found in the contents of the cysts of the liver. Some of the larger cysts were punctured and portions of the wall removed for microscopic examination. Polycystic disease of the kidneys was noted during this exploration. When this man was aged seventy-six, he was again examined at the Clinic for migraine.

The largest cyst in this group was approximately 3 by 3 by

3 cm., and the smallest was approximately 2 cm. in diameter. In most cases almost the entire liver was composed of innumerable small cysts.

The walls of the cyst in all four specimens were composed of fibrous connective tissue. In two, bile ducts and hepatic cells were present in the wall. The bile ducts were sometimes dilated

FIG. 76.—Simple cyst whose wall is lined by flat epithelium. In the cyst cavity are hepatic cells and blood cells in varying stages of degeneration; in the wall are areas of lymphocytic infiltration and many bile ducts. Some of the latter are apparently dilated (×75).

(Fig. 75). The hepatic cells usually revealed degenerative changes and old and recent hemorrhages were frequently found in the wall of the cyst. The lining of the cysts was composed of flat to cuboidal epithelial cells. The bile ducts in the walls of these cysts were not so plentiful as in multilocular cysts of the liver. In

one of the cysts the lining cells were apparently parenchymal cells of the liver.

Simple cysts.—There were two cases of simple cysts. These were found in a man aged forty-seven, and a woman aged sixty-five. In one the left lobe of the liver was involved and in the other the right lobe. Both patients complained of pain in the epigastrium coming on within ten minutes after eating. One patient vomited occasionally. The other patient was relieved of the distress by lying down. One had a leukocyte count of

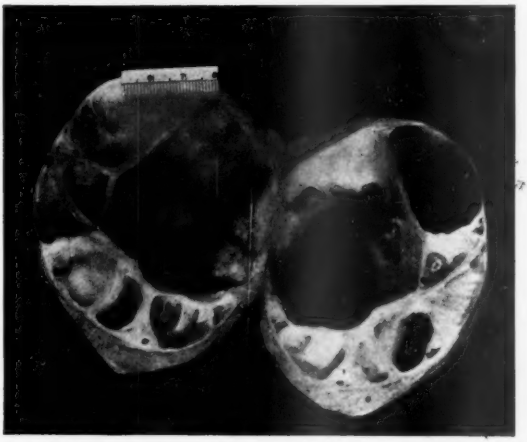

FIG. 77.—Multilocular cyst in the case of a boy aged four. Many trabeculations of the wall are shown. In the right half of the cyst in the largest cavity is a black area, a hemorrhage in the wall.

11,000 at the time of the examination. Both patients had a palpable epigastric mass, one tender, the other not. At operation simple cysts of the liver were found; the smaller was 6 by 3 by 2 cm., the larger 8 cm. in the greatest dimension.

The walls of the simple cysts of the liver were composed of fibrous connective tissue, lined by cuboidal epithelium. In the wall were many bile ducts, some of which were dilated, hepatic cells, and occasionally lymphocytes. The hepatic cells in the wall of the cyst revealed varying stages of degeneration (Fig. 76).

Multilocular cysts.—The six patients with multilocular cysts included one boy aged four (Fig. 78), a man aged twenty-six, and four women aged from forty-five to sixty-eight years. The average age for the entire group was forty-one years. In three cases the right lobe of the liver was affected by the cysts, in one case, the left lobe, and in one both lobes; in one case the cyst was not definitely located. Most of the multilocular cysts seemed to be localized around the gallbladder fossa and near the insertion

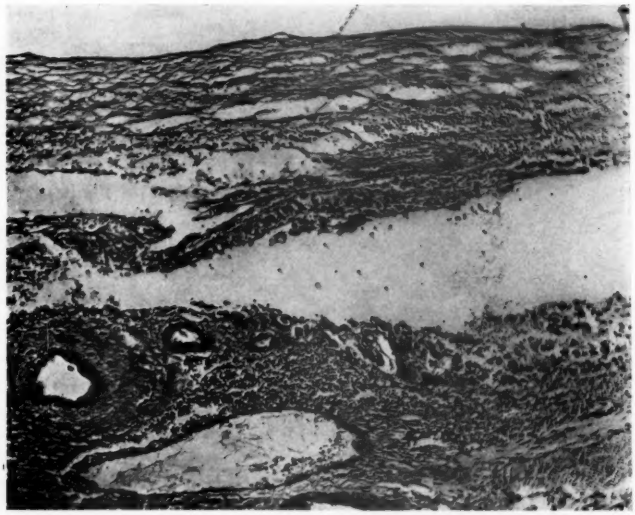

FIG. 78.—At the top is the lumen of the cyst lined by a single layer of flat epithelium. In the fibrous wall are areas of lymphocytic infiltration. Near the center of the wall and to the right of it are many hepatic cells. To the left of the center is a dilated bile duct (×75).

of the round ligament into the liver. The most common symptom complained of by these patients was pain, which was present in five of the six cases. In two cases the distress was localized in the epigastrium, in one along the right costal margin, in one in the right upper quadrant of the abdomen, and in one the pain was not definitely localized. Four of the six patients complained of radiation of pain, one to the right shoulder, one to the left flank

and chest, one to the back, and one between the shoulder blades. Two patients complained of sharp pain, three of dull pain, which usually came on from a half to one hour after meals. The pain usually occurred in attacks which lasted from a day or two to two or three weeks. Usually there was an interim of freedom from symptoms. Three patients stated that the abdominal distress was aggravated by jolting and deep breathing. In four of the six

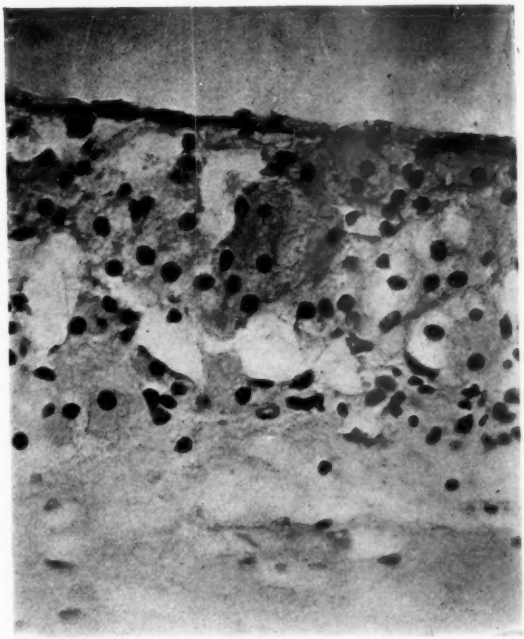

FIG. 79.—Hepatic cells in various stages of degeneration form the wall of a cyst (×350).

cases a palpable tumor was present. Two persons suffered a loss in weight, probably due to the fact that they voluntarily limited their food because of abdominal distress after eating. Three of the six patients of the group had attacks of vomiting usually accompanying the attacks of pain. In two cases the leukocytes numbered 16,000 and 12,000, respectively. One case was that

of a boy aged four with a short history, and the other was that of a woman whose case has been previously described by Harrington.

The size of the multilocular cysts removed at operation varied from 3.5 to 35 cm. in the greatest dimension. The contents of the cysts varied from clear, serous, or watery fluid to blood-tinged or milky fluid. Occasionally crystals were found floating in the contents of the cysts.

FIG. 80.—Columnar epithelium in the lining of a cyst. In the wall are many bile ducts (×150).

The walls of the cyst were usually composed of white fibrous connective tissue, and some of the specimens were marked with hemorrhagic spots. Trabeculation was usually present in the walls, probably due to the breaking of one cyst into another (Fig. 77). The chief element of the walls of the cyst was fibrous

connective tissue, and concentrated in this wall were bile ducts and hepatic cells. In two of the specimens the bile ducts were dilated (Fig. 78); in the remainder this was not found. In one specimen hepatic cells in various stages of degeneration were the most prominent feature of the walls of the cyst (Fig. 79). These cells formed almost all of the wall. In another specimen the hepatic cells were present as isolated groups. Distinct columnar epithelium formed the lining of one cyst (Fig. 80); in three the lining cells were flat to cuboidal epithelium and in two epithelial cells were not found lining the cysts. These two cysts had extensive degenerative changes and lymphocytic infiltration of the wall. In those cases in which there was flat to cuboidal cells in the lining of the cyst, the morphology of the lining cells was similar to that of the cells of the bile ducts which were usually present in the wall, suggesting the possibility of their common origin.

CYSTS DISCOVERED IN THE COURSE OF AN ABDOMINAL OPERATION

Nine of the twelve patients who had cysts removed in the course of abdominal operation for some other purpose were women. Nine of the operations were for cholecystectomy, two for duodenal ulcer, and one was exploration because of chronic pancreatitis. The largest cyst of this group was 5 by 4.5 by 3 cm., and the smallest was 5 mm. in diameter. In only one case, that of multiple multilocular cysts, was there more than one cyst. The remainder of the specimens were small simple cysts, and this probably accounted for the absence of symptoms and the discovery incidental to laparotomy.

The microscopic data in these twelve cases were essentially the same as those in the cases in which symptoms were present. The most striking feature of the structure of the cysts was the fibrous connective-tissue wall which usually contained hepatic cells, bile ducts, or both. Occasionally areas of hemorrhage or lymphocytic infiltration were also present. The bile ducts in the walls of two cysts were apparently dilated; these cysts were the largest and the smallest in the group. Flat to cuboidal epithelial cells were present in the lining of the cysts in the group, with only

two exceptions (cysts in which a definite lining could not be discovered).

COMMENT

From my observations the symptoms of cysts of the liver vary directly with the size and situation of the cyst. Small cysts are symptomless regardless of their complexity and large cysts deep in the parenchyma of the liver are usually "silent." Hemorrhage into a small cyst, however, may cause acute symptoms. The most common complaint of the group of patients with cysts of the liver was attacks of abdominal cramps often associated with a palpable epigastric tumor. Approximately two-thirds of the patients were women. Only one of the twenty-four patients was a child; the cyst was multilocular and complete relief was afforded by operation. If cysts causing symptoms can be removed surgically, the results are practically always good.

The common occurrence of dilated bile ducts in the walls of the cyst suggests that cysts may originate from dilated ducts.

SUMMARY

Twenty-four cases in which nonparasitic cysts of the liver were removed at operation were studied. In twelve of these the cyst produced symptoms. Four of these patients had polycystic disease of the liver. Abdominal pain was complained of by all four patients. The duration of symptoms varied from four months to several years. Three patients had palpable abdominal tumors. Two patients had simple cysts of the liver which gave symptoms. Both complained of epigastric pain. Six patients had multilocular cysts of the liver that gave symptoms. These cysts were the largest of the entire series. The most common complaint of this group of patients was cramp-like attacks of abdominal pain with intervals of freedom from pain.

In all the cysts there was a capsule or wall of fibrous connective tissue which was usually lined by flat to cuboidal epithelium. Hepatic cells, bile ducts, areas of hemorrhage, and lymphocytic infiltration were present in the wall of the cyst in some of the cases. The only definite microscopic difference among the retention cysts was in the simplicity or complexity of the walls. The large

cysts gave symptoms and the small cysts (less than 5 cm. in the greatest dimension) were symptomless. The presence of many dilated bile ducts in the walls of the cyst in some of the cases suggested a possible etiologic factor. All the patients in whom the cyst could be removed were relieved of symptoms.

BIBLIOGRAPHY

1. Castelli: Quoted by Kaufmann.

2. Ewing, James: Neoplastic diseases. Ed. 3, Philadelphia, W. B. Saunders Co., 1928, 731–732.

3. Harrington, S. W.: Traumatic retroperitoneal rupture of the duodenum; traumatic intraperitoneal and extraperitoneal rupture of the duodenum; strangulated Meckel's diverticulum in right femoral canal; solitary nonparasitic cyst of the liver. Surg. Clin. N. Amer., 1926, vi, 1185–1193.

4. Henderson, M. S.: Cyst of the round ligament of the liver. Ann. Surg., 1909, l, 550–551.

5. Jones, J. F. X.: Removal of a retention cyst from the liver. Ann. Surg., 1923, lxxvii, 68–89.

6. Kaufmann, Eduard: Lehrbuch der speziellen pathologische Anatomie. Berlin, Walter De Gruyter and Company, 1922, 748–750.

INTESTINAL OBSTRUCTION FOLLOWING THE WEBSTER-BALDY OPERATION FOR RETROVERSION

JOHN DE J. PEMBERTON AND W. WARREN SAGER

THE cases reported here demonstrate the technic used in performing the operation for retroversion. This technic is mentioned specifically in Webster's original description of the operation which bears his name; that is, the suturing of the broad ligaments to the round ligaments at the points of perforation of the broad ligaments. In Webster's first description of the operation in 1901 he said: "Each ligament is also stitched to the edge of the hole in the broad ligament." The omission of this part of the classical technic was, I believe, the direct cause of the intestinal obstruction which occurred in one of our cases several weeks after the operation. Richardson, in 1920, reported the only case of a similar nature that we have been able to find either in a review of the literature or the histories of cases in which operation was performed in The Mayo Clinic. He reported a case of obstruction following a Webster-Baldy type of shortening of the round ligaments in which retroversion was also found at operation. He stated: "The round ligament on the right side was drawn through the broad ligament, which may have been thin, too far away from the body of the uterus, and possibly through too large an opening. Any strain on the round ligament would tend to make it cut through the broad ligament toward the body of the uterus, and the median line. This tendency would be increased by the recurrence of the retroversion. In this way an open perforation of considerable size through the broad ligament might persist. Given perforation and recurrent retroversion which tended to make of the broad ligament a shelf-like partial diaphragm more or less perpendicular to the axis of the pelvis, it is easy to see how a loop of intestine dropped through."

The operation was described by Baldy in 1902. In a paper published in 1909, he stated that both he and Webster had performed this operation "for the same length of time, with exactly the same principles but varying slightly in technic."

The first of our two cases is that of a woman, aged thirty-nine years, who gave a history which was indicative of disease

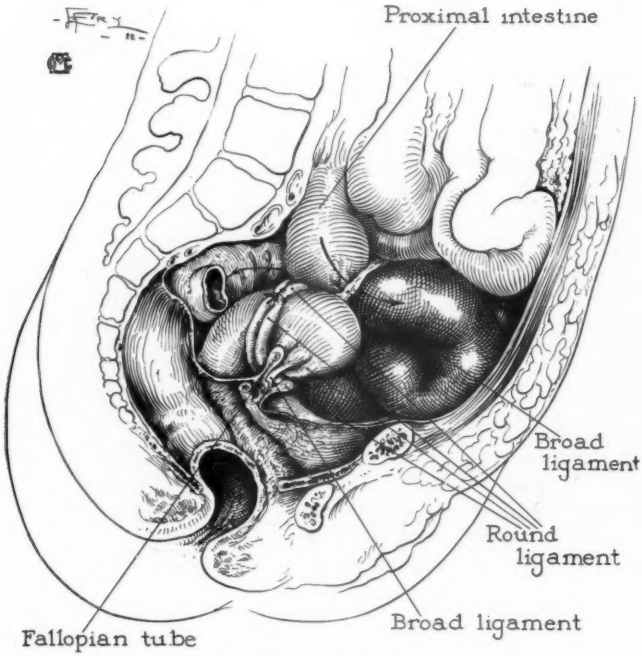

FIG. 81.—Obstructed loop lying over the bladder.

of the appendix. General examination did not reveal anything abnormal. Pelvic examination showed a markedly retroverted uterus.

Abdominal exploration was carried out through a median-line incision. The appendix was chronically inflamed and the uterus was definitely retroverted. The appendix was removed, and a Webster-Baldy operation performed, curved forceps being

used to perforate the broad ligaments just below the utero-ovarian ligament. Each round ligament was pulled through this perforation in a double fold and sutured to its fellow and to the posterior surface of the uterus. The edges of the rents in the

FIG. 82.—Strangulated loop passing through the broad ligament.

broad ligaments were not sutured to the round ligaments. The patient convalesced normally and was dismissed from the hospital at the end of two weeks. Ten days later about 8 o'clock in the morning severe colicky pains developed in the lower part of the abdomen; this was followed by vomiting. The pains were inter-

mittent all day, with recurrent vomiting. The vomitus was only slightly bile-tinged. At 6 o'clock in the evening the patient was sent to the hospital and several enemas were given, all of which were ineffectual. The patient was seen about 10 o'clock that night, at which time there was slight tenderness in the lower part of the abdomen, but no distention; the pulse, temperature, and leukocyte count were normal. However, she complained of great tenderness in the lower part of the abdomen. Pelvic examination showed a sausage-shaped distended cystic mass on the left side. A diagnosis of incarcerated, strangulated intra-abdominal hernia was made. Operation was performed at 11 P. M., about fifteen hours after the onset (Figs. 81 and 82).

A low median-line incision was made. The peritoneal cavity contained bloody fluid and caught in the pelvis was a loop of bowel, 20 or 30 cm. in length, which was distended and appeared black and gangrenous. The loop was about 2 meters from the ileocecal valve; it had passed through the left broad ligament, through the aperture recently made during the Webster-Baldy operation, and had become strangulated. To release the loop of bowel the left ovary and tube were removed, and the broad ligament was cut. After the peritoneal cavity was packed off, this loop of bowel was removed and the two ends were brought together by end-to-end anastomosis. On completion of the anastomosis a lateral anastomosis was made about 15 cm. above and below the first anastomosis, as the lumen of the bowel seemed definitely encroached on at this site. About 15 cm. above the point of the lateral anastomosis, enterostomy was performed.

The patient's postoperative convalescence was uneventful. The catheter used in making the enterostomy drained well from the time of insertion. At no time was there any clinical evidence of obstruction or of infectious peritonitis.

This case is unusual and instructive from several viewpoints. As we have mentioned, we have been able to find only one other similar case. The two cases are similar in that they occurred after the same type of operation, and they call attention to the advisability of suturing the round ligaments to the broad ligaments at the points of perforation. There are, however, certain

anatomic differences which deserve mention. In our case the uterus had not retroverted but was well forward, and the perforations were made in the broad ligaments close to the uterus and just below the uteroövarian ligament. The small intestine, instead of herniating from the anterior aspect of the broad ligament posteriorly, herniated from the posterior aspect anteriorly. Several points relating to the surgical procedure at the second operation should be mentioned. The patient's excellent condition warranted the resection, thus reducing the surgical problem to obtaining an anastomosis which would work, securing relief for the slightly distended bowel above, and avoiding contamination. The first part of the problem was solved by the use of both an end-to-end and a lateral anastomosis, when the lumen from the first anastomosis seemed lessened definitely. The drainage of the bowel was accomplished by enterostomy. This procedure is recognized as extremely valuable in surgery of the intestines. By establishing immediate and adequate drainage the danger of tension on the anastomotic sutures with potential leakage consequent to the distention of postoperative ileus is effectually averted. All care possible was taken to prevent contamination. The postoperative management, however, was based on the hypothesis that such soiling had taken place. The patient was kept well under the influence of morphin which was given regularly at intervals of three to five hours for several days, and then alternately with codein. When she was able to expel gas by rectum without the aid of a rectal tube, on the fourth postoperative day, she was given small amounts of fluid by mouth.

The second case was that of a married woman, aged thirty-six years, who gave a history of having had a Webster-Baldy operation performed twelve years prior to coming to the Clinic. Her chief complaint was that of irregular profuse menses. Examination revealed multiple fibromyomas of the uterus. The uterus reached almost to the umbilicus. Hysterectomy was advised (Fig. 83).

The abdomen was explored through a median-line incision. It was noted that at the site of the Webster-Baldy operation, at the points where the round ligaments perforated the broad liga-

ments, there were two large openings in the broad ligaments, either of which would admit two fingers. These openings potentially were a source of danger for intestinal obstruction, although there was no evidence of this. Total abdominal hysterectomy was performed.

In our search of the literature we were unable to find a case reported similar to this. Obstruction following various types of

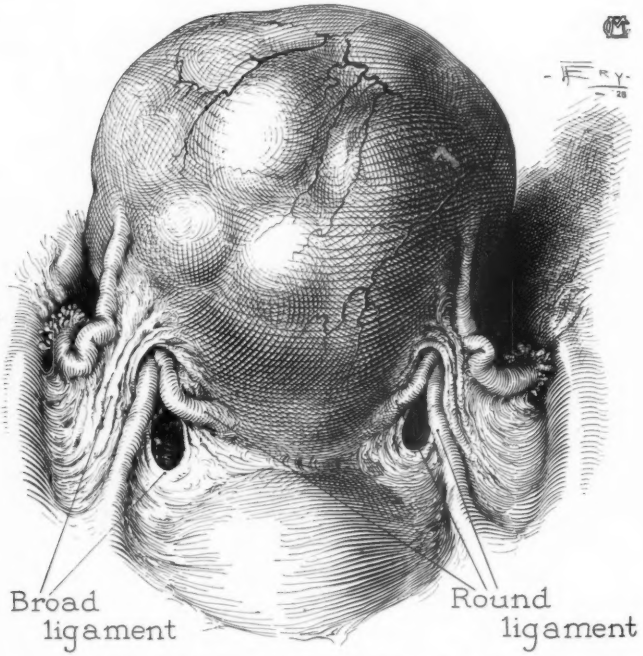

FIG. 83.—Webster-Baldy operation complicated by a fibromyomatous uterus; large openings may be noted in both broad ligaments.

operations on the round ligaments is rare. In 100 cases of acute obstruction of the small intestine in which secondary operation was performed at The Mayo Clinic, only sixteen could be traced to pelvic operations, and none except the case just cited resulted from operations on the round ligaments. Six of the sixteen ob-

structions followed hysterectomy, two followed myomectomy, one followed removal of a part of the body of the uterus, one followed puncture of an abscess in the pouch of Douglas, and one followed a cesarean section. The remainder were due to operations on the tubes and ovaries. The cause of the obstruction in all the cases was adhesions. The time of onset of the obstruction varied from four days to thirty-four years. As a cause of postoperative obstruction pelvic operations are third in this series, being surpassed by the number of obstructions (thirty) which occurred following appendectomy, and by the number of high obstructions (seventeen) caused by operations on the stomach.

ACUTE INTESTINAL OBSTRUCTION

CLAUDE F. DIXON

ACUTE intestinal obstruction is one of the most hazardous of emergency surgical conditions. In a great many instances it has been comparatively easy to relieve the apparent obstruction, but the disconcerting factor has been, and still is to a lesser extent, that the outcome was likely to be fatal. A great deal has been written on intestinal obstruction during the last few years. When acidosis was thought to be more common than it is today, a patient who was admitted with intestinal obstruction, dehydrated from vomiting, with a florid complexion, dry skin, and so forth, was often thought to have severe acidosis due to mechanical interference of the motor mechanism of the intestinal tract, or to intestinal obstruction.

Advancement of knowledge of the chemistry of the blood has shown that alkalosis is present instead of acidosis, and that in a case of acute intestinal obstruction in which surgical intervention is necessary for relief, preliminary medical treatment is of the utmost importance, and has unquestionably decreased the mortality in such cases markedly. Even the more chronically obstructed cases, such as cases of duodenal ulcer in which obstruction and gastric retention have become marked, showed chemical changes in the blood characteristic of intestinal obstruction: elevation in the blood urea, and in the carbon dioxid combining power of the plasma, and lowering of the plasma chlorids. As has been mentioned, the cases which are not associated with complete obstruction show definite changes from normal in certain chemical estimations of the blood. The three cases presented here are of interest mainly because the patients recovered.

Case I.—A man aged twenty-seven years was admitted to The Mayo Clinic September 4, 1928, because of severe, paroxysmal cramp-like pains throughout the lower part of the abdomen, associated with frequent vomiting. The symptoms were sudden in onset and of three days' duration. Morphin had been administered at intervals for pain. Eight months previously a gangrenous appendix had been removed through a McBurney incision. Convalescence was uneventful.

On examination the patient presented the characteristics of toxemia so frequently seen in upper intestinal obstruction, a florid, dry, parched skin, temperature 97° F., and pulse 84. He was in a definitely lethargic state, except during the paroxysms of abdominal cramps. On gastric lavage 500 c.c. of thin, brownish material was obtained which had a definitely fecal odor. The urine showed many hyaline and granular casts. Leukocytes numbered 16,800. The blood urea was 56 mg. for each 100 c.c., and the plasma chlorids were 495 mg. for each 100 c.c. There was moderate distention of the entire abdomen with tenderness over the right lower quadrant. An intestinal pattern could not be made out. Immediately following the examination, 1,000 c.c. of a solution of 10 per cent glucose and 1 per cent sodium chlorid was given intravenously, and a like amount was again given in four hours, after which the abdomen was opened, under procain and ethylene anesthesia, through a right rectus incision.

The small intestine was dilated to five or six times normal size. A band was found extending from the cecum to the inner border of the mesentery of the ileum; under the band were caught several centimeters of intestine. The band was severed. Because of the marked distention of the ileum, a Witzel type of enterostomy was performed, using a 20 F. catheter, which was drawn through a small opening in the omentum and thence a stab wound in the median line. The incision was closed without drainage.

The day following operation the temperature rose to 104° F. and pulse to 160. There was good drainage from the enterostomy tube. One thousand cubic centimeters of 10 per cent glucose and

1 per cent sodium chlorid was administered intravenously twice each twenty-four hours for three days following the operation. Then for three days 1,000 c.c. of the solution was given intravenously and increasing amounts of fluid given by mouth, beginning with 30 c.c. of water each hour. On the sixth postoperative day the patient's temperature was normal. The blood urea was 26 mg. for each 100 c.c. and the chlorids 595. Urinalysis was negative. The enterostomy tube was removed on the tenth postoperative day. Drainage from the wound ceased after twelve hours. The patient was dismissed from the hospital on the thirteenth postoperative day, and from the Clinic on the sixteenth day with both wounds completely healed.

Intestinal obstruction following appendectomy is a fairly common complication, of which Case I is an example. It was felt before operation that the most probable cause of the obstruction was adhesions or bands produced from the recent appendicitis; for this reason careful and gentle exploration of this region was made; the band was found and loosened. Enterostomy was carried out because there was apparently definite paresis of the intestine which contained a large amount of thin, watery fluid.

Case II.—A man aged sixty-seven years was admitted to The Mayo Clinic, November 30, 1927. He was placed in hospital immediately. Three days before admission he was suddenly seized with a cramp-like pain in the lower part of the abdomen, which had been present constantly with intermittent exacerbations. Vomiting had occurred frequently; the vomitus was thin, brownish, and bile-stained, and during the last day had a definitely fecal odor.

The patient was emaciated and semicomatose, and the skin was flushed and dry. The temperature was 97° F., and the pulse 70. The leukocytes numbered 9,300. The blood urea was 150 mg. for each 100 c.c. The urine showed albumin, graded 2, many hyaline casts and a few granular casts. The abdomen was moderately distended, and there was definite diffuse tenderness.

Fifteen years previously the appendix had been removed through a McBurney incision.

A small, low, left rectus incision was made under procain anesthesia. The small intestine was markedly distended. The first loop brought into view was apparently a part of the ileum. A Witzel type of enterostomy was made hurriedly. Omentum could not be found to cover the site of the enterostomy. The tube was brought out through a stab wound, care being taken to place the suture line of the enterostomy against the peritoneum. Exploration was not carried out; the rectus incision was closed without drainage.

Immediately following the operation 1,000 c.c. of 10 per cent glucose, and 1 per cent sodium chlorid was given intravenously; 3,000 c.c. of this solution was administered each twenty-four hours for four days. There was good drainage from the enterostomy tube. The immediate postoperative course was stormy; definite cyanosis developed, which subsided after oxygen was administered for forty-eight hours. The blood urea dropped to 40 mg. for each 100 c.c. in six days. Urinalysis was negative. On the eighth postoperative day, the patient had a normal bowel movement, which occurred daily thereafter. The enterostomy tube was removed on the fifteenth day. There was slight drainage from the enterostomy wound for three days, and then the wound closed. On the twentieth postoperative day, marked parotitis developed on the right side which subsided after a stubborn course of four weeks. Normal bowel movements continued, and the patient was dismissed on the sixtieth postoperative day. The patient was recently heard from; he has felt well since dismissal.

The cause of the obstruction in this case was not determined. A possible explanation is that a loop of intestine may have been fenestrated through some adhesions around the site of the appendectomy and righted itself later. This case is an example of intestinal obstruction of unknown cause which subsided after enterostomy. Exploration was not made because the freeing of any bands or adhesions which may have caused it would in all probability not afford recovery. Also exploration in the pres-

ence of such marked distention of the intestine is unwise because it has been definitely demonstrated that the slightest trauma to a distended intestine is likely to cause the passage through its walls of bacteria with resultant fatal peritonitis. Local anesthesia is advisable in every case if possible. General anesthesia apparently increases this already hazardous procedure tremendously.

Case III.—A man aged fifty-nine years registered at The Mayo Clinic October 24, 1927. After examination a diagnosis of gout was made, and he was hospitalized for treatment. After about two weeks of treatment, he complained of fulness in the abdomen which had appeared during the preceding twelve hours. He had not had abdominal pain, cramps, or tenderness.

Examination showed the abdomen to be definitely tympanitic and moderately distended. Appetite was good; there had been no nausea or vomiting. Bowel movement had been fairly good during the preceding days. The leukocyte count was only slightly elevated. The temperature was normal. It was thought that the condition might possibly be due to a rich carbohydrate diet, which had changed the intestinal flora and thereby caused a great deal of gas. The condition gradually grew worse. the distention became more marked. The following three days the bowels did not move, and enemas were ineffective. At the end of the fourth day the patient presented the usual characteristics of shock and was slightly cyanotic.

Under local anesthesia a right McBurney incision was made with the idea of performing cecostomy to relieve the ileus. When the peritoneum was opened a large amount of gas escaped. There was some free fluid in the abdomen, and the odor was characteristic of contamination by colon bacilli. The ileum presented and because of its marked distention, enterostomy of the Witzel type was performed; through which 1,500 c.c. of liquid fecal material drained the first twelve hours. Drainage continued freely. The immediate convalescence was stormy. Hot turpentine stupes were applied to the abdomen. Intravenous injections of 10 per cent glucose and 1 per cent sodium chlorid

were given in amounts of 2,000 c.c. (divided doses) each twenty-four hours for four days; then fluids were given by mouth.

The ileostomy opening did not close. The patient was discharged from the hospital on the thirty-second postoperative day. The bowels were moving well through the rectum. There was slight drainage through the ileostomy opening. The patient was sent home for two months. On his return a roentgenogram of the gastro-intestinal tract was negative. There was still drainage from the ileostomy opening. The general condition was good. Closure of the enterostomy opening was advised, but it caused only slight inconvenience and the patient preferred not to have any further surgical procedure at that time.

COMMENT

Cases I and II were clear-cut cases of intestinal obstruction due to mechanical causes. The site of obstruction was not found in Case II. It was probably caused by adhesions at the site of the appendectomy through which a loop of bowel had become fenestrated. Enterostomy afforded drainage and allowed the intestine to resume its normal size, and evidently freed the obstructive site.

In Case III the pneumoperitoneum was at least suggestive of a perforated viscus. The history was negative for peptic ulcer or diverticulosis, and a subsequent roentgenogram of the gastro-intestinal tract was negative. Some cases of pneumoperitonitis which have come to necropsy have not shown perforation of a viscus. Whether the diet in this case caused distention of the intestinal tract, which became so marked that organisms passed through the walls, is a question. It is probable, even though there was no definite mechanical obstruction in this case, that the marked ileus caused the same profound toxemia as that seen in such obstruction. From this case and others of ileus which have been observed, it would seem logical to assume that in certain postoperative cases of peritonitis which prove fatal the toxemia from the ileus is as much a factor in the cause of death, or in some cases more so, than the actual infection.

The disturbance in the chemical constituents of the blood in

intestinal obstruction or ileus has become well recognized during the last few years. The mortality in intestinal obstruction, even though these changes are corrected, is high, especially in the late cases.

Wangensteen and Chum were able to show that the intestinal content below the obstruction was just as toxic as that above the obstruction.

Jejunostomy has been advocated by certain authors in cases of intestinal obstruction. Drainage of the jejunum has the same effect as a duodenal fistula. If a tube is placed in the jejunum as a method of feeding the patient, its purpose is well accomplished. If an opening in it is made for the purpose of drainage it merely hastens death, as does persistent duodenal fistula.

The most important factor in the treatment of intestinal obstruction is early operation, as it has always been. This, however, cannot be done when the patient comes late with that frequent sign not of obstruction but of impending death, fecal vomiting.

The mortality in intestinal obstruction has been reduced. This is probably due to many factors. The preoperative preparation is extremely important. After the diagnosis is made, glucose and sodium chlorid should be administered intravenously; 1,000 c.c. of 10 per cent glucose and 1 per cent sodium chlorid may be given slowly and repeated in a few hours. The stomach should be lavaged and then operation performed. The operative procedure should by all means be carried out under local anesthesia if at all possible. If considerable time has elapsed, an attempt should not be made to find the obstruction, but enterostomy should be performed. If the tube is brought through the omentum, on its removal closure will occur almost spontaneously and save another hazardous procedure later. If the enterostomy tube is brought out through a small stab wound the incision can be closed and sealed off, thereby preventing infection of the wound and separation.

From 2,000 to 3,000 c.c. of glucose and sodium chlorid should be given each twenty-four hours after operation. The blood should be examined daily; if the blood chlorids rise above nor-

mal, glucose may be given without sodium chlorid, or the amount of sodium chlorid may be increased to 2 or 3 per cent. Gastric lavage should be carried out two or three times daily, depending on the degree of retention.

BIBLIOGRAPHY

1. Wangensteen, O. H. and Chum, S. S.: Studies in intestinal obstruction. Comparison of toxicity of normal and obstructed intestinal content. Arch. Surg., 1928, xvi, 606–614.

SPINA BIFIDA: PREOPERATIVE, SURGICAL, AND POST-OPERATIVE TREATMENT

WINCHELL MCK. CRAIG

WITHIN the last decade, successful surgical results have become increasingly dependent on three lines of endeavor excluding diagnosis; namely, preoperative care, postoperative care, and improved technic. The surgical treatment of spina bifida consists in plastic repair of the hernial sac. The difficulties encountered at operation depend on the type and condition of the lesion.

Spina bifida is congenital lack of closure of the arches of one or more vertebræ with meningeal protrusion. Anatomically, there are three types, depending on the contents of the hernial sac. If the meninges alone protrude into the sac, the hernia is known as a meningocele; if, in addition, some of the nerve-fibers or a portion of the spinal cord itself bulges into the sac, it is known as myelomeningocele. If the neural canal is involved and herniates with the meninges, the condition is known as syringomyelocele.

The underlying cause of these congenital anomalies never has been truly understood. Whether lack of closure of the arches of the vertebræ constitutes cause or result, or the existing condition depends on the increase in pressure in the cerebrospinal fluid in utero, the fact remains that some form of treatment must be instituted to rehabilitate the unfortunate victims. Complicating the decision as to the proper form of treatment, are associated deformities such as hydrocephalus, congenital subluxation of the hip, syndactylism, exstrophy of the bladder, harelip, and cleft palate. Sometimes the condition of the hernial sac influences the type of treatment. In extreme cases the covering of the sac is

deficient, and the vertebral canal and maldeveloped spinal cord are exposed, or the soft tissues over the protrusion are thin and allow the escape of cerebrospinal fluid.

Surgical plastic repair of these hernial sacs is the treatment of choice, but if such treatment is instituted indiscriminately, the results are far from satisfactory. In the first place, if the repair is attempted immediately after birth, the mortality is at least 50 per cent. Furthermore, a certain definite percentage of these cases is handicapped to such a degree that growth and development are impossible and the span of existence is limited. Operation not only fails to improve the condition of the patients, but hastens death. The most common complication is hydrocephalus, which may or may not become stationary and which is not improved by operation. With these facts in mind, the ultimate problem resolves itself into one of selecting cases for operation which can be benefited with as little risk as possible. The ideal cases are those of simple meningocele not complicated by hydrocephalus. Myelomeningocele and syringomyelocele can be operated on, but definite improvement cannot be promised with regard to the condition of the lower extremities or of the sphincters.

In view of the proved high mortality rate in operating too soon after birth, a definite time limit should be determined. The most suitable time for operation on spina bifida is when the patient is from nine months to two years of age. At an earlier age the operative mortality is very high. After the age of nine months, the child is old enough to take nourishment besides milk and usually stands the operation well. However, it is not advisable to postpone operation beyond the age of two years. The hernial sac is likely to become very large and this increases the risk of its being ruptured; then, too, the child is up and about and slips away from the mother's care.

Previous to advising operative procedure, a thorough examination should be made to determine the child's general condition, the possibility of hydrocephalus, and the absence or presence of paralysis. It is important, too, to discuss the prognosis with the parents; frequently parents are led to believe that

the operation will relieve the paralysis as well as remove the hernial sac.

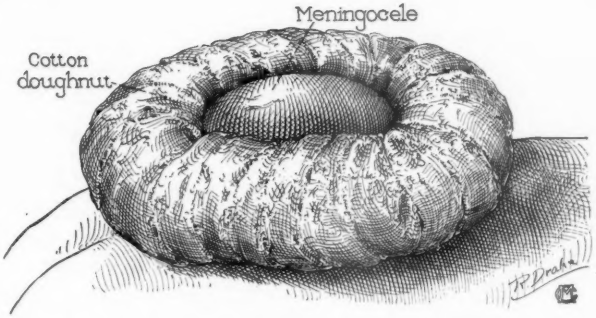

FIG. 84.—Cotton doughnut used to protect spina bifida.

Since the operation should not be instituted in spina bifida until the child has reached the age of at least nine months, the problem of preoperative treatment during the intervening

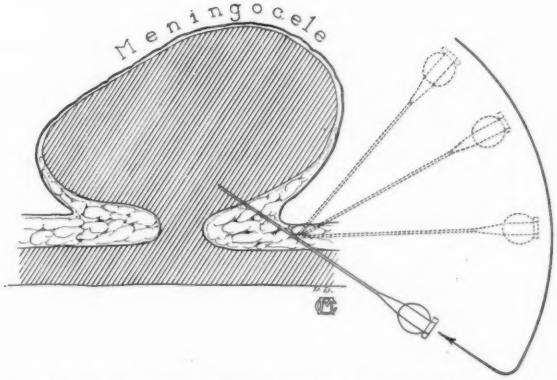

FIG. 85.—Aspirating the sac without inserting the needle directly through the wall.

months must be considered. If the wall of the sac is thin, the movements of the child threaten rupture and subsequent infection; consequently, a doughnut of cotton bandage should be

applied for protection (Fig. 84). Should the wall become eroded in places, allowing the escape of cerebrospinal fluid, powdered boric acid should be applied two or three times a day, and the sac should be aspirated, as shown in Figure 85. Repeated aspirations of the sac reduce the danger of associated infection, and also have a tendency to stabilize any degree of hydrocephalus which may be an associated complication. Also, in the intervening months, the general care of the patient should be kept uppermost in mind and the child should be given the advantage of proper diet and plenty of fresh air. After the age of eight or nine months, a decision can be reached as to operability with regard to the risk involved and the amount of benefit to be expected. Indications for treatment depend on the degree of the congenital defect. Infants in poor physical condition without demonstrable motor power or sensation in the lower limbs, and with a loss of sphincter control, should not be operated on. Although these infants may survive the operation, improvement in the limbs or in the sphincters will not occur, and development of hydrocephalus will not be prevented. In cases in which there are no coverings to the sac, and the undeveloped spinal cord is exposed, operative interference is absolutely contraindicated. Cases in which the hydrocephalus already has shown a marked advance should be excluded, also, from operation. Surgical interference is indicated in all cases of spina bifida in which the movement of the lower limbs is not at all, or only slightly, impaired; that is, in closed or in communicating meningocele, removal of a local deformity is followed in many cases by normal development. It is fairly common, however, for some disturbance of motor power and of sensation to be discovered as the child grows older. Talipes, or drop foot, especially, may require supporting apparatus or tendon plastic operation after the child has begun to walk.

The case reported here is that of a baby boy who was observed from birth until the age of eight months, and given proper preoperative treatment. Although there was a small amount of hydrocephalus, exploration and plastic repair were performed successfully, following repeated aspirations of the sac and, when

the child was seen six months after the operation, he appeared normal and healthy (Figs. 86 and 87).

FIG. 86.—Large meningocele before operation.

Following normal delivery the child was found to have a large meningocele, about 9 cm. in diameter, in the lumbosacral region. The sac was partially covered with a very thin, tissue-

FIG. 87.—Well six months following operation.

paper-like membrane. Otherwise, the baby seemed absolutely normal, but the attending physician gave a guarded prognosis as to the ultimate outcome. The tumor gradually increased in

size until at the time of examination it was as large as the baby's head, approximately 14 cm. in diameter. At birth, the meningocele was draining cerebrospinal fluid, although an opening was not apparent, but after a few days drainage ceased and since that time cerebrospinal fluid was discharged intermittently.

General examination was essentially negative. Examination of the eyes was negative. Roentgen-ray examination of the skull was negative. Roentgen-ray examination of the spine showed absence of the spines and laminæ of the lower lumbar and upper sacral vertebræ. The hemoglobin was 80 per cent, erythrocytes numbered 4,220,000, and leukocytes numbered 10,300 with 2.5 per cent large mononuclear leukocytes, 4 per cent transitional cells, 27.5 per cent neutrophils, 2.5 per cent eosinophils, and 1.5 per cent basophils. Neurologic examination revealed a strong baby with a slightly hydrocephalic head. There was some relaxation of the anal sphincter and the tendons to the hamstrings were hyperactive, as well as the patellar reflexes. The Achilles' reflexes were diminished. The large meningocele in the lumbosacral region was found to transmit light and did not appear to contain nerve filaments.

In view of the diagnosis of meningocele with an exceedingly thin sac which was allowing the escape of cerebrospinal fluid, the baby was sent to the hospital for observation April 11, 1928. Previous to this, the attending pediatrician had been tapping the meningocele every month, removing about 150 c.c. of clear cerebrospinal fluid, which had seemed to control the escape of fluid from the sac. With this in mind, the hospitalization was for the purpose of aspirating the sac, and clearing up any infection of the surface. At the hospital moist alcohol dressings were applied to the entire surface of the sac, and a doughnut of cotton was applied for protection. The following day, 600 c.c. of clear cerebrospinal fluid was aspirated from the sac, which allowed it to collapse. The next day 450 c.c. was aspirated, and the sac was strapped to the back, but it refilled again. As a result of the daily repeated aspirations the escape of cerebrospinal fluid ceased, and the external surface of the sac became clean and dry. However, an untoward result of the aspirations was the dehydration of the

patient. Consequently, physiologic solution of sodium chlorid was administered subcutaneously and operation was advised.

April 17, when the baby was eight months old, he was anesthetized with ether and placed in a prone position, with the head lower than the body. The sac was opened through a longitudinal incision. There was an escape of clear cerebrospinal fluid, and

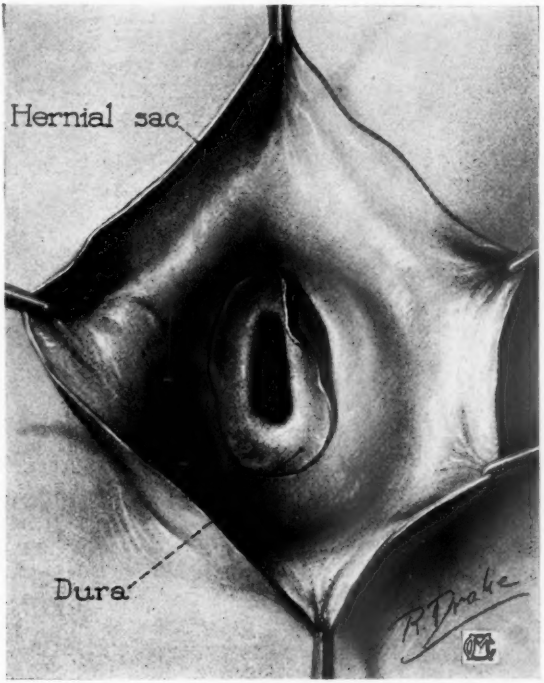

FIG. 88.—Longitudinal incision over the sac as well as the incision of dura.

on inspection the protrusion proved to be a simple meningocele without nerve-fibers inside the sac. The dura was incised and the edges were approximated so as to close completely the opening in the meninges (Figs. 88 and 89). The redundant skin was then incised, and the fascia dissected and approximated. A third layer of sutures was placed in the subcutaneous tissues and

another layer in the skin (Fig. 90). Over the incision was then placed collodion and this dressing was secured by straps of adhesive. The skin sutures were removed at the end of the seventh day, and the wound was found to have healed by primary union.

In the presence of such a large sac which refilled so readily, the postoperative treatment was carried out with the idea of

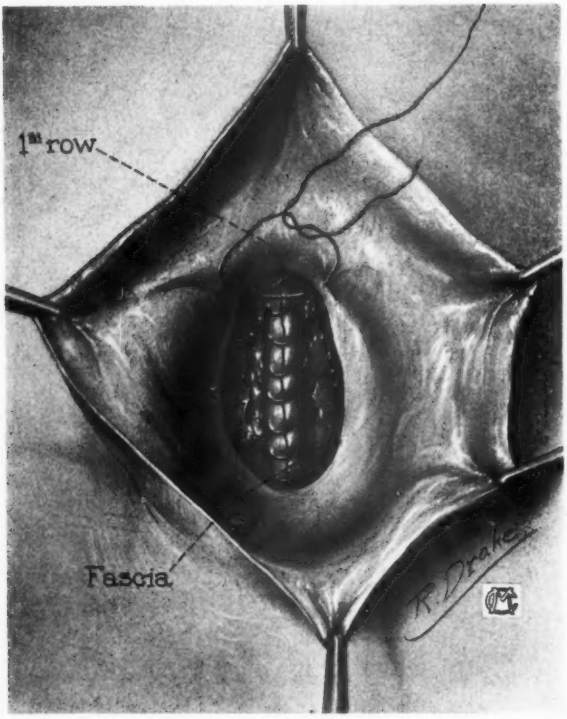

FIG. 89.—Closure of dura and approximation of the fascia.

forestalling any complications. An increase in the cerebrospinal fluid pressure was anticipated and spinal punctures were done every four hours for two days, but as there was no perceptible rise in pressure, these were then discontinued. There was slight postoperative elevation in temperature which was

combated with ice-bags to the axillæ, tepid sponges, and colonic flushings. For the first few days the child refused nourishment and the subcutaneous administration of physiologic solution of sodium chlorid was given. Under this treatment the child's condition improved, and on the third day he was taking nourish-

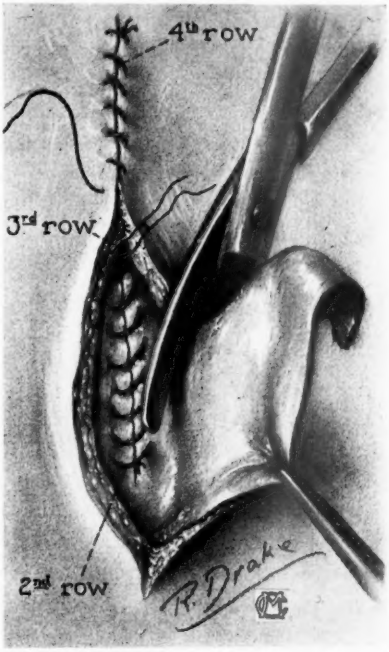

FIG. 90.—Final step in the operation.

ment. From then on the convalescence was uneventful and he was dismissed from the hospital on the tenth day.

October 8, six months after the operation, the parents brought the patient in for observation, and he was found to be normal in every respect. The neurologic symptoms which had been present at the time of operation had cleared up and the wound was in excellent condition.

OPERATIVE TREATMENT

Various plastic operations have been described for the excision of spina bifida and the closure of the defect. Plastic operations on the bone are never justifiable. Ether is the anesthetic of choice, and the patient is placed on the abdomen, with the head slightly lower than the body, so that when the hernial sac is opened the fluid within the ventricles will not drain into the spinal canal. A longitudinal incision over the entire sac should be made, opening into it without any further dissection. This exposure shows whether or not there are any nerve elements present and, if so, makes it possible to treat them. If the hernial sac is a simple meningocele, it is closed in three layers, approximating the cut edges of the dura and the fascia of the subcutaneous tissue. If the spina bifida is a myelomeningocele (a sac containing nerve elements) the nerve fibers are divided close to their exit from the point in the spinal canal, and replaced within the spinal canal together with the spinal cord, before closure is made. If the sac contains a part of the spinal cord itself, then it becomes necessary to close the opening superficially to the cord structure. After closure has been effected, the edges of skin are approximated with dermal sutures and the wound dressed with collodion to prevent contamination, and the baby is returned to its room and placed in the prone position, with the head lower than the body.

The postoperative care is very important, inasmuch as a frequent complication is a tendency to hyperthermia. Consequently, the temperature should be carefully watched and, if a definite elevation takes place, tepid sponges, ice-bags, and colonic flushings should be used in an effort to control the rise in temperature. In some cases repeated spinal punctures have been of use, also in controlling any tendency toward postoperative increase of cerebrospinal fluid. It may be necessary to use physiologic solution of sodium chlorid injected under the skin in amounts of 250 c.c. twice a day when the child fails to take nourishment. The control of the elevation in temperature is very important because experience has shown that if the temperature rises to 105° or 106° F. it is difficult to reduce; whereas

if the temperature is prevented from rising above 103° F. the thermal center has a tendency to adjust itself and remain at a lower level.

The sutures should be removed on the seventh day and, for support, the wound strapped with adhesive tape for at least two weeks after the operation. Before the patient is dismissed, a complete neurologic examination should be made as a check on the preoperative examination, and to establish the exact status of the patient. This should be done so that if there are any areas of anesthesia, any motor defects in the lower extremities, or any loss of tone in the anal sphincter, they can be recorded. Should this condition be complained of later on in life, and ascribed to the operation, the record will show that these conditions were due to the congenital anomaly and not to the operation itself.

CONCLUSIONS

The surgical treatment of spina bifida should be delayed until the patient has attained the age of nine months.

The hernial sac should be protected in the meantime by a doughnut of cotton and care should be taken to prevent abrasion and infection.

The sac should be aspirated to relieve the tension and prevent enlargement.

Simple meningocele responds most satisfactorily to plastic repair although the less complicated myelomeningoceles may show improvement after operation.

Postoperative observation and care are essential in obtaining the most successful results.

ANAL FISSURE

LOUIS A. BUIE

ANAL fissure is an ulcerous lesion situated usually in the posterior quadrant, often in the posterior commissure, occasionally in the anterior quadrant, and rarely in the lateral margins of the anus. As a rule it involves the external portion of the anal outlet, and rarely extends internally as far as the pectinate line. The terms, irritable ulcer, intolerable or intolerant ulcer, and fissure-in-ano, have been popular among those who have written on the subject during the last half century. Previous to that time, however, owing to the lack of suitable diagnostic equipment, such as anoscopes and lighting appliances, there was considerable confusion as to the true nature of the disorder.

One of the most comprehensive of the early accounts and probably the first article written was prepared by Aetius in 1542. Bodenhamer advised that the old fissures be treated by paring, or by scarifying their edges with a sharp instrument, and then applying suitable dressings, and so forth. Boyer, Blandin, Velpeau, and Becklard wrote on the subject during the latter part of the eighteenth and the beginning of the nineteenth centuries.

Even with modern equipment there seems to be as much need for accurate information now as there was in the time of the "ancients." One of the chief reasons for this, I am sure, results from the fact that the term "fissure" has been used prevalently in designating the disorder. Had it been called "irritable anal ulcer" exclusively from the first, I believe there would have been much less confusion. It is remarkable that the simple matter of terminology could have such a marked bearing, not only on the interpretation of the character of the condition, but also result in the improper treatment of more or less inoffensive lesions which are

not true anal fissures. It is a rather prevalent idea among members of the medical profession that any crack or abrasion around the anal margin is a fissure, and on the discovery of such a lesion the patient is forthwith advised to submit himself to a "touching up" process with some type of chemical or actual cauterant. Under such circumstances it often happens that a slight break in the marginal skin of the anus, which might easily have healed under the cleansing effect of a few hot enemas and applications of witch-hazel, is converted into a true anal ulcer or fissure, which ultimately requires radical treatment for relief.

ETIOLOGY

Fissures probably occur most frequently as a result of trauma. Ball attributes most of them to tearing of the semilunar valves during the passage of a large formed stool or some such traumatic influence. He claims that the tear becomes infected and the ulcer gradually extends outward with an edematous tag at the margin, the so-called sentinel tag. If this were true, we would always find that the pectinate line internal to the fissure would be broken through and this rent would be continuous with the fissure. It is well known that such a condition is rarely seen. In fact, I am quite sure that such a lesion is not a fissure at all, but an infected and ulcerated crypt, which is easily diagnosed, and rarely extends more than 1 cm. externally to the remainder of the normal pectinate line. All fissures I have seen occur independently of a rupture of the pectinate line, and it is characteristic to see an enlargement of the papillæ of Morgagni internal to the fissure. Usually, on inspection of the anal orifice, the sentinel tag is seen first. As the anus is exposed, the fissure is seen, and with sufficient dilatation the papilla is seen. With any infective process of the anus or crypts of Morgagni, the papillæ become involved with edema and inflammatory changes, and thus enlarged. With subsidence of the inflammation fibrosis results and the papilla rarely returns to its normal size. Therefore, since inflammation of the anal canal is always associated with a fissure the enlarged papilla is a characteristic complication.

Although Ball's theory appears untenable, the fundamental factor in his argument, infection of the anal crypts, is, I believe, the underlying cause of anal fissure. It develops, however, in a very different manner from that which he described. The anal crypts are susceptible to infection on the slightest provocation, and are responsible for much of the trouble that develops in that region. The source of all anal fistulas can be traced to these little pockets behind the pectinate line, and I believe, that many hemorrhoids develop as a result of phlebitis of the hemorrhoidal veins which is caused by infection entering through the anal crypts. In like manner, thrombus will develop in a venous space with diseased walls; anal papillæ are affected directly by extension from the crypt infection; acutely painful conditions with anal spasm arise as a result of generalized involvement of the anus which has extended from cryptitis. There are many similar ailments that can be traced in this manner.

SYMPTOMS AND CLINICAL COURSE

Proper regard must be given to the significance of the little pockets which lie just behind the margins of the skin where it overlaps the mucosa with a serrated border. Care must be taken, however, to avoid the very natural error of trying to account for too many bizarre and distant ailments by supposed disease of the crypts and papillæ. I sound this warning because of the many instances in the past in which practitioners have erred in offering to relieve bizarre and foreign complaints that could have no possible association with the region to which the treatment was applied. There are individual physicians, unfortunately, who still engage in these practices. I feel, therefore, that it is necessary in the same breath with which I call attention to the anal crypts and their significance in the production of anorectal disease, that I specify the pitfalls which accompany overestimation of their importance in the production of symptoms which are not characteristic and not located in the anorectal region.

With infection in the anal crypts there is extension under the skin about the anal margin, which not only involves the subcu-

taneous stroma, but the skin. The anus is then susceptible to the effect of traumatic influence of any sort, and it is under such circumstances that the break occurs resulting in the fissure which is in every particular a varicose ulcer. This theory agrees well with Pennington's explanation of the fact that most fissures are situated in the posterior anal quadrant and the next most frequent site is in the anterior quadrant. He stated: "The chief predisposing factor is anatomic, that is, due to the support given to the anal canal by the levatores ani." These muscles are continuous around the lateral aspects of the anus, but anteriorly and posteriorly the levator muscles join instead of encircling the anus. The result is that there is comparative weakness there, inasmuch as with pressure from within, the muscles are more likely to split anteriorly or posteriorly than they are to break across the fibers laterally. And of course with such a split the skin breaks immediately over it and fissure results. The reason that more fissures occur posteriorly than anteriorly is because of the angulation of the posterior rectal wall with the canal of the anus at its posterior internal margin, whereas the anterior rectal wall continues almost in a straight line with the anterior anal canal (Fig. 91). Because of this anatomic characteristic there is much more pressure exerted posteriorly as the fecal mass is forced over the anorectal margin. Thus an ulcerous lesion develops as a result of trauma exerted on diseased anal skin, the infection of which originated in the anal crypts. The fissure is situated posteriorly because of anatomic peculiarities and is intractable because of the phlebitis and varicosities which are also due to the original cryptitis, the infected secretions bathing it, and the spasticity of the muscles.

Anal fissures do not differ from ulcers in any other part of the body. They are usually single, and when more than one is present, according to Pennington, the condition is often specific. Owing to the condition about the anorectal outlet, response to treatment is slow. The veins are diseased and the term varicose ulcer of the anus might well be applied to anal fissure. The sphincters, always in a contracted state, have their power augmented by the muscle spasm resulting from the anal irritation.

Pathologically, then, a varicose ulcer is usually found with a sentinel tag externally and hypertrophied papilla internally, diffuse anal infection, the severity of which is usually comparable

FIG. 91.—Acute angle formed by the juncture of the posterior rectal wall with the anal canal.

to the acuteness of the fissure, and anal spasm. In acute stages the spasm is elastic and clonic; the alternate contractions and relaxations produce not only considerable wear on the ulcer, but extreme discomfort. However, in chronic cases of long-standing

infection with alternate healing and breaking down of the fissure, there is a fibrous deposit within the muscle bundles of the sphincters which destroys their elasticity. On digital examination after dilatation to the limit of elasticity, which is usually lesthan 2 cm., such an anus imparts the "feel" of a bone ring around the examining finger. In the treatment of anal fissure it is im, portant to keep these two types of contracted anus in mind. With the elastic type simple dilatation of the external sphincter is sometimes sufficient, but with the inelastic type it is necessary to break up the fibrous bands by overstretching the anus. In both instances, however, the surgical removal of the fissure is also necessary.

Anal fissures, although insignificant in size and appearance, are productive of the most severe symptoms, and the general prostration appears to be out of all proportion to the size of the lesion. The explanation of this apparent paradox is not difficult. Acute or chronic ulcers anywhere in the body are painful enough, but in this region one would expect the discomfort to be increased. The constant exposure to irritative discharges and the "grinding" contraction of the anal muscles are the chief agonizers. Muscle spasm produces pain and pain produces spasm. Ultimately the anal sphincters become overdeveloped. The resistance of the hypertrophied muscles and the fibrosis within them causes further interference with bowel function and resultant constipation. Thus the vicious circle is completed. The local pain of an acute fissure is agonizing and it is not uncommon to see a patient with such a lesion completely prostrated following the act of defecation. The pain is usually greatest during the passage of the stool, and the duration of the discomfort varies proportionately with the acuteness of the ulcer. Convulsions have been known to occur (Pennington), and a case has been recorded in which the patient was accustomed to inhale chloroform each time he went to stool. Pain may last for many hours; in fact, it may remain constant.

Pain extending up into the lumbar area, into the hips and down the thighs and legs is often associated, but does not occur as a rule, unless there is also pain at the anus. I mention this

because it so often happens that a physician is consulted by a patient with obscure backache or "sciatic" discomfort with the hope that a rectal condition can be found that will account for the complaint. In general, unless a lesion is present of sufficient gravity to produce symptoms at the anus, it is quite probable that it will not explain these distant discomforts. I have seen arthritic disorders, such as pain and stiffness in the knees, ankles, or elbows, clear up following the cure of an old anal abscess or other chronic infected anal lesion, but the significant fact is that the local disorder was causing local discomfort, and was productive of local signs, such as discharge of pus or blood. Care should be taken not to submit a patient to the treatment of some supposed anorectal disease which does not exist, and even if it did, would be incapable of producing the symptoms of which the patient complains. It is common to find records in earlier literature of cases in which cure has been promised for nervousness, constipation, palpitation, impotency, dyspepsia, headache, insanity, and, it seems, anything that might have been desired, by treatment of the anal pockets. Even now certain practitioners have an undue regard for the so-called atrophic, hypertrophic, catarrhal, and other types of proctitis. The significance which some still attach to the valves of Houston in the production of constipation is very surprising and the present-day practice of valvotomy, which is still being carried on, is to my mind, comparable to the treatment of anal pockets as advocated and developed by the ancients.

The spasmodic reaction of the anal sphincters is the most troublesome and most common complication of anal fissure, and is due to the same infection which causes the ulcer. For some reason fissures will heal spontaneously and just as often they will recur. The explanation of this is not clear, but theoretically it could be due to the stretching influence of a large formed stool, which breaks the ulcer margins, causing an outpouring of exudate sufficient either to seal the edges of the ulcer or to produce a thin protecting membrane which relieves the symptoms temporarily. Usually after such stretching, which is accompanied by intense pain, the patient becomes more attentive. He in-

spects the stools and perhaps finds a little blood. Possibly he uses an ointment and takes laxatives to soften the stool or he may take enemas. In this manner an aid is given to healing, and the acute condition may subside. Always, however, the recurrence comes as a result of constipation, diarrhea, or some unusual strain. So as time goes on, with these recurring infections and periods of healing, a fibrous deposit collects in the sphincter muscles which accounts for the contracted inelastic anus which is also a complication of anal fissure.

Hypertrophy of the anal papillæ is often associated, and many times these projections on the pectinate border assume sufficient size to prolapse from the anus. At such times they are nearly always designated as polyps by those who are not familiar with the structures in the anorectal area. It is important to make a correct diagnosis under such circumstances. Polyps should always be removed by a burning operation because they are potentially malignant. Hypertrophied papillæ should always be excised cleanly and never burned, because they involve the part of the margin of the skin which possesses the most prolific sensory nerve supply. Burning operations, therefore, are followed by the most painful convalescence and, due to the penetrating effect of the cautery, the slough about the skin of the anus will often double the period required for complete healing.

One of the few instances in which it is legitimate to promise relief for "distant" complaints in connection with anal diseases is that of constipation, which is also a complication of anal fissure. The prognostication of relief from constipation and its associated gastric and abdominal disorders by cure of anal fissure is justified. It is well, however, to inquire into the history and learn whether the inactivity of the bowel existed before the onset of the anal lesion. I have found that the anus of such a patient might have borne infection for a long time previous to the actual break into a fissure and this state of affairs might have been coincident with the onset of the habit of constipation. Usually, therefore, when the anal fissure is cured, simply by the additional help of a carefully planned anticonstipation diet, a great deal of gratifying response is experienced by the patient. It is not

sufficient, however, merely to give the patient a dietetic list to be followed at home. The matter should be discussed very carefully and if possible, a period of about a week should be spent by the patient taking all meals from a suitable diet kitchen and studying the preparation and kinds of foods to be used in the diet.

Abscesses may occur in association with fissures and also fistulous tracts, which appear to originate in the ulcer, but which probably started in the crypt infection before the tissues at the margin broke down. These abscesses and infections may go on with more extensive involvement and develop into perianal, perirectal, or perineal cellulitis. A complication which should be remembered, chiefly because it is unusual, is the abscess which develops in the groin as a result of the extension from the marginal lymph spaces around the anus, over the perineum, and into the inguinal lymph nodes. I know of such a case in which the abscess was incised and the patient treated for syphilis until a complaint was made of pain on defecation. When the anus was properly examined a fissure was found and excised, and the inguinal abscess healed.

METHODS OF TREATMENT

It is not surprising that the usual methods of treating anal fissure have failed in most instances to produce permanent relief. All varicose ulcers require extreme care if healing is to be secured. Thus it has resulted that the application of actual and chemical cauterants has produced only temporary relief, and often none.

The most universal treatment of recent years has been that of simple divulsion of the anal sphincters. Its effects have been partially satisfactory when compared with other remedies, but the rationality of its usage is extremely doubtful, especially when we consider that anal fissures are entitled to most careful treatment. An excuse for the existence of this practice is the fact that it is supposed to incapacitate the sphincters and establish a condition of rest in the anal canal, thereby allowing the fissure to heal. However, one has but to view the distortion following such manipulation (especially in the prevailing unclean postoperative

state) to be spurred to some effort in an attempt to improve the situation. The divulsion must incapacitate the anal sphincters, but with this result there are also numerous breaks in the skin around the anal margin; the muscle fibers are ruptured, thrombosis develops, and contusions appear. Infection is admitted through the anal abrasions and edema develops, thus explaining the prolonged discomfort and permanent distortions usually following such maneuvers. Even permanent incontinence has been known to follow the procedure.

A better method of treatment than divulsion is the subcutaneous sphincterotomy as advocated by Martin,* which places the anus in a state of rest by cutting the sphincters subcutaneously through a small puncture wound made about 2 cm. posterior to the anal margin. In this manner the fissure is allowed an opportunity to heal without distortion of the anal margins or muscles. Since the very earliest writings it has been advised to cut out the fissure entirely and sever the outer half of the external sphincter in that locality, and those who have practised it report that they have obtained splendid results. I have used both of these methods, particularly the latter, and have been much pleased with the results although in some cases, the outcome has not been entirely satisfactory. The chief difficulty has been associated with the excision of the ulcer, and the cutting of the sphincters, and it seems that in spite of the fact that I excised the ulcer widely (especially posteriorly to the anus) occasionally the skin would be drawn in such a manner as to cause pocketing at the anal margin. This has sometimes left an area of moisture which remained sensitive and was only relieved by cutting the scar, and even then the result was not always entirely satisfactory. On several occasions the entire pocket had to be taken out again. It was because of this that a more radical procedure was tried, the method of which I shall describe.

RADICAL OPERATION

The patient fasts the night before and the morning of the operation. A rectal injection of 90 c.c. of mineral oil and 500 c.c.

* E. G. Martin—Detroit.

of water is given during the previous evening, to be retained all night. About two hours before the operation another oil-and-water enema is given, and expelled after about twenty minutes. A hypodermic of $\frac{1}{6}$ grain of morphin is administered a half hour before the patient is taken to the operating room. Anesthesia of the area to be operated on is accomplished by a regional in-

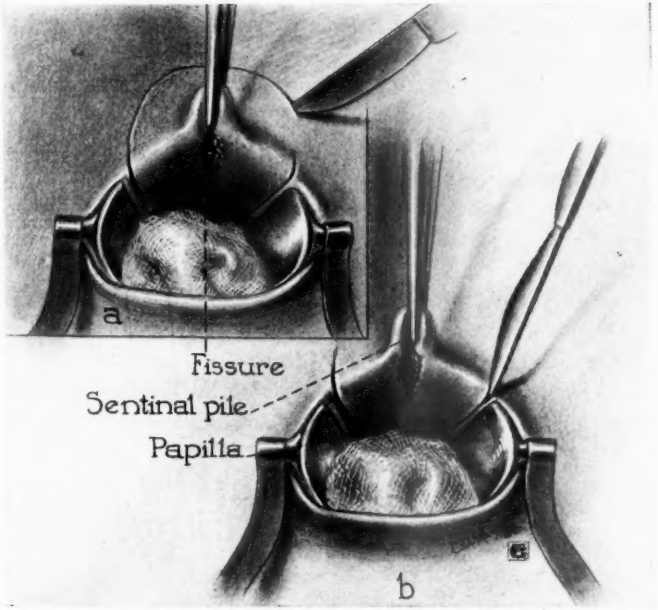

FIG. 92.—*a*, Curved incision posterior to the anus; *b*, incisions made at right angles to the sphincteric fibers of the juncture of the lateral and posterior quadrants of the anus.

jection of 1 per cent procain, usually given into the first and second sacral foramina and through the sacral hiatus. Sometimes the sacral hiatus is sufficient and at other times some or all of the remaining sacral nerves must be infiltrated. After cleansing of the lower part of the rectum with witch-hazel, if there is any residue of feces, 3 per cent acetone solution of mercurochrome is used to prepare the operative field. This is not often

necessary since the preparation before the arrival of the patient in the operating room is usually sufficient.

A retractor which was designed recently by my associate, N. D. Smith, and a description of which follows, has proved very satisfactory. The most distinct advantage attendant on its use is the acility with which two opposite walls of the anal canal can be viewed at the same time. The anterior or posterior walls are entirely exposed when the flanges are retracted laterally and the right and left walls are brought into view when retraction is made anteroposteriorly. The instrument is most useful when the anus is anesthetized. The bulge on the inner third of each flange reduces the possibility of slipping of the instrument out of the anus, and it is unnecessary to have an extra assistant at the table for the purpose of holding the pair of retracting forceps usually applied to the anal margin. It does not produce the contusions and abrasions around the anal margin usually produced by other instruments used for retraction.

The illustrations afford a clear idea of the manner of performance of the operation. First, incisions are made through the skin of the anal margin at right angles to the external sphincter fibers (Fig. 92, *b*), at the juncture of the lateral and posterior quadrants of the anus on either side. These points are not always the same and one should be guided in determining them by the necessity of removing tags or varicosities in conjunction with the remainder of the diseased tissues in order to secure a smooth margin. Often I have made the incision at the middle on both sides and have excised the entire posterior half of the anus during the operation. The external incision is begun at the margin of the anus externally and connecting the outer ends of the lateral incisions forms a curve posterior to the anus which is about 3 cm. from the anal margin at its farthest point (Fig. 92, *a*). The inner extremities of these incisions are carried just through the pectinate line so that another incision connecting the inner limits will cut across the mucosa just above that margin (Fig. 93). Then this whole area, with the fissure, marginal varicosities and scars, is dissected out down to the external sphincter leaving a denuded area and exposing the external sphincter (Fig. 94, *a*). A con-

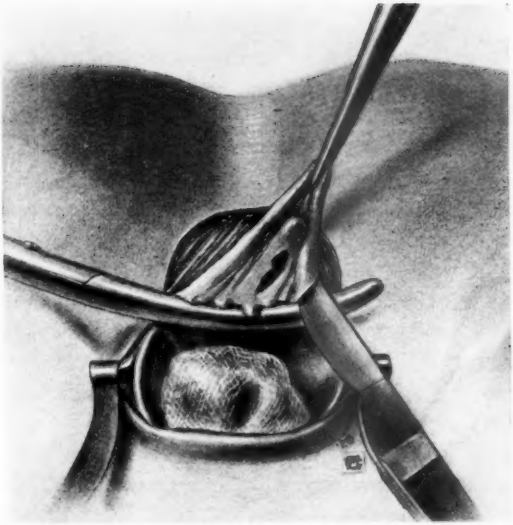

FIG. 93.—Excision of mucosa, skin, fissure, papilla, and external tag.

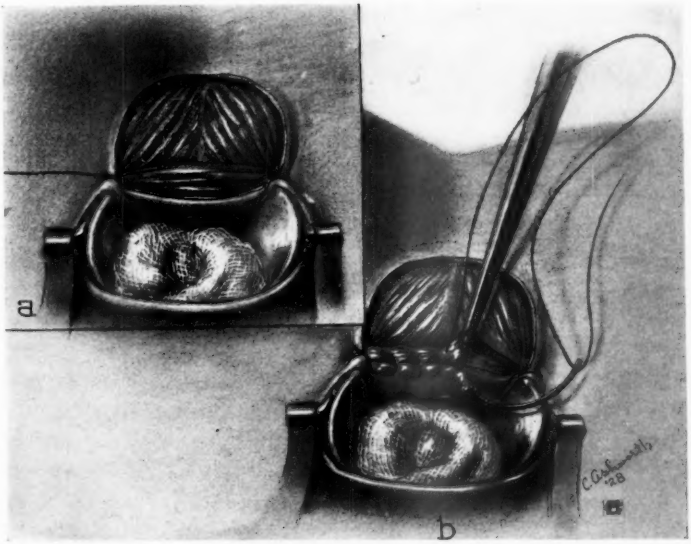

FIG. 94.—*a*. Exposed external sphincter; *b*, method of suturing mucosa into the external sphincter.

tinuous suture is started at either end of the wound laterally, and carried across to the other side in order to tie the free edge of the mucosa into the central portion of the external sphincter muscle (Fig. 94, *b*). In some instances in which the external sphincter is greatly hypertrophied it is advisable to cut through about half of the muscle fibers. I prefer to use a Lembert type of suture because it turns in the margin of the cut mucosa against the muscle fibers in such a way as to preclude all possibility of bleeding. It is most desirable that all wounds in this area be as free of bleeding as possible since dry wounds heal more satisfactorily. The operation is completed by inserting a small drain of iodoform gauze inclosed within rubber tissue, and the application of a gauze dressing.

Hot wet dressings are used hourly from the second to the eighth hour after the operation. A general diet is permitted and the patient's bowels move forty-eight hours after the operation. This movement is stimulated by withdrawal of the rubber tissue drain from the anus and if desirable the administration of a mild laxative the third night. I have found the selection of the laxative to be very important, and I never prescribe the same dose or type for all patients. A mild dose for a constipated patient will produce numerous stools in one with normal habits. I therefore ask the patient what he usually takes to produce one satisfactory movement and prescribe accordingly. The anus is irrigated with warm water and witch-hazel after each stool during the following fifteen days, and the wound is dressed daily with such antiseptic medicaments and cleansing applications as are desired. Among our armamentarium we have found dichloramin T., 3 per cent mercurochrome, witch-hazel, parathesin, thymol iodid, and bismuth formic iodid powder very useful. The patient is usually confined to bed for two days, and at the end of two or three weeks the wound is entirely healed.

AN ANAL RETRACTOR

NEWTON D. SMITH

THE instrument described here has been designed to accomplish ample and efficient exposure in operating on the rectum or anus. To those who have difficulty in obtaining proper assistance in performing this type of operation the instrument should be doubly useful, for it will supply constant satisfactory exposure without the aid of an additional assistant. It is intended that the retractor should be used only when a patient has been properly anesthetized.

The retractor is simply constructed, and it can be manipulated easily. The convexity at the distal ends of the retracting blades, *d* and *d'*, is increased to make them self-retaining. The blades are also hinged at *e* and *e'*, so that when the retractor is in use the body of it can be deflected to one side; *c* and *c'* are the retracting arms and with the shaft, *i*, form the body of the instrument. The retracting arms have been made with a gentle curve to conform with the presenting part, regardless of the angle at which the blades are placed. The retracting arm, *c'*, is fixed to the shaft *i* at *j*, and the arm, *c*, slides on the shaft, *i*, by means of a slot through the part designated *h*. This slot through *h* is of sufficient length to supply ample leverage when pressure is exerted on the blade, *d*, toward the blade *d'*, to prevent their approximation after they have been placed in the desired position; *a* and *a'* are continuations of the retracting arms above the shaft to facilitate manipulation of the blades.

The whole instrument is designed to conform to the field of operation in such a way that it will not interfere with the application of clamps, the insertion of needles, and so forth. Another noteworthy feature is that the whole canal can be examined without having to withdraw the retractor. This can

be accomplished by merely turning the instrument, still in place, through an arc of 90 degrees. Before using the anal retractor it is essential that the anus should be dilated very gently to a diameter that will permit insertion of three fingers. The blades, *d* and *d'*, are brought in apposition by pressure on *a* and *a'*. A suitable lubricant is then applied to the blades, and they are introduced

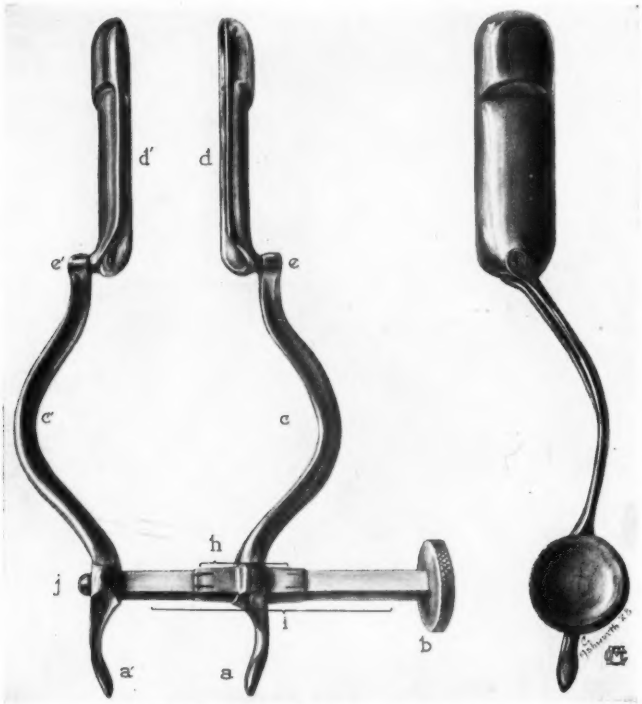

FIG. 95.—Anal retractor. (See text.)

well into the anal canal. Then by drawing *a* toward *b*, the blades are opened the desired distance and the body of the instrument deflected to the side which will permit the greatest ease in the procedure to follow.

The instrument lends itself especially well to this type of operation performed with the patient in the prone position, with

hips slightly elevated, but will assuredly be of great aid when the lithotomy or Sims' position is used. It has been found most useful in operations on fissures in ano, fistulas in ano, the so-called blind internal fistulas, hypertrophied anal papillæ, and infected crypts.

The retractor is a mechanical aid to the proper accomplishment of a surgical procedure and, being mechanical, it should never be used to dilate the anus.